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1917/18

ANNUAL REPORT  
OF THE  
**WATER COMMISSIONER**

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OF THE  
CITY OF ST. LOUIS  
FOR THE  
YEAR ENDING APRIL 1st, 1918





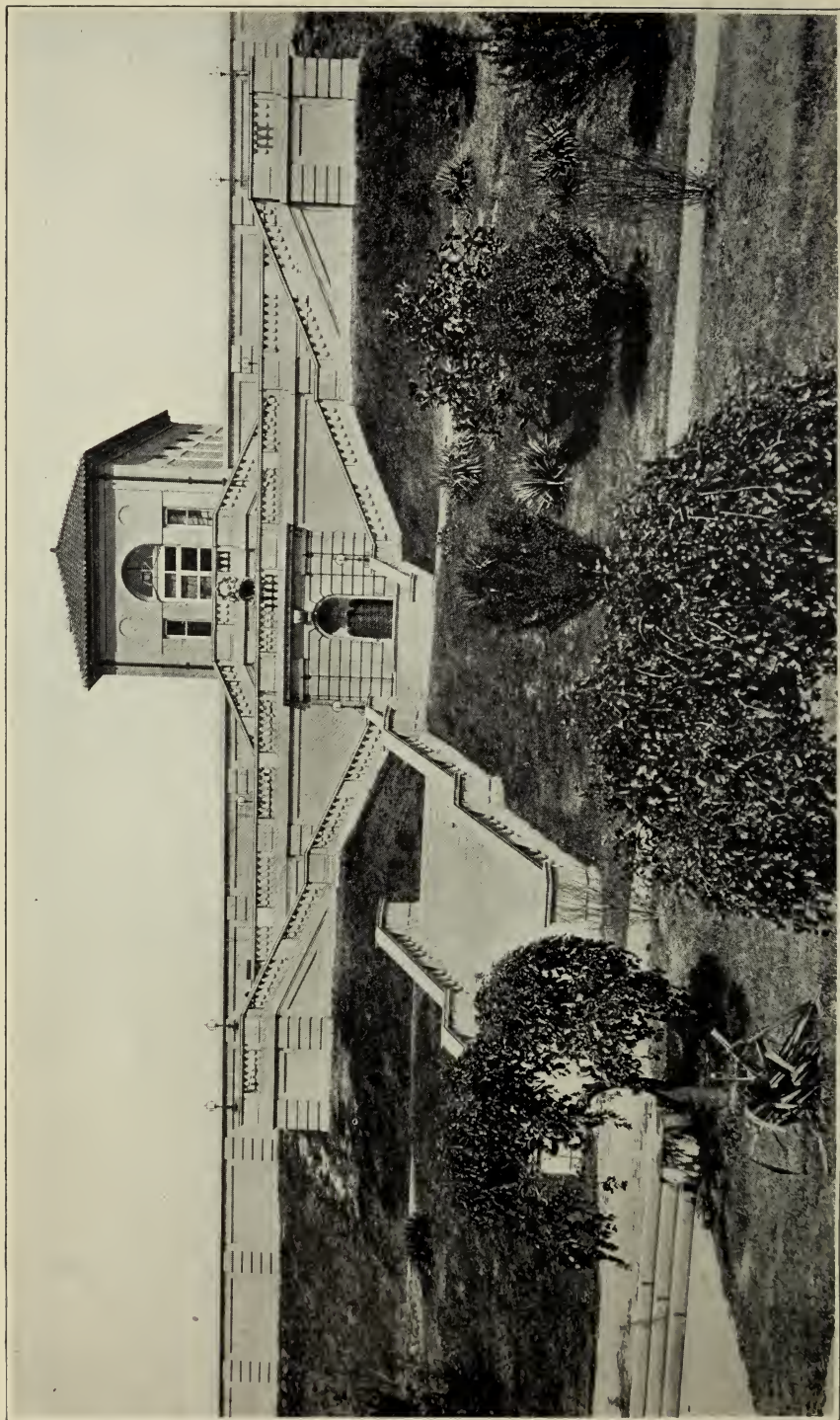
REMOTE STORAGE

COMPLIMENTS OF

*air*

*Edmund B. Wall*

WATER COMMISSIONER



STAIRS GATE HOUSE, COMPTON HILL RESERVOIR.

DEC 13 1918

ANNUAL REPORT  
OF THE  
WATER COMMISSIONER  
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Sa 2

1917/18

## REMOTE STORAGE

21Mm19 direct 24 1917/18 cont.

TELEPHONE SERVICE CHART  
ST. LOUIS WATER DIVISION  
1918

CITY HALL	BISSELL'S POINT	BADEN	CHAIN OF ROCKS	SERVICE STATIONS	OTHER STATIONS	RESIDENCE PHONES
WATER COMMISSIONER'S OFFICE Bell Main 5580 Kinloch Central 154 Central 3840 (Gen Office 57q 40)	Asst Water Com Office Bell Colfax 716 Kinloch Central 154 Municipal Phone	OPERATING SECTION Office Bell Colfax 655 Kinloch Central 153	OPERATING SECTION Office Bell Colfax 521 Kinloch Central 152-L	WALNUT STREET Bell Belmont 150 Kinloch Central 432 Municipal Phone	CONDON HILL RESERVOIR	E E WALL WATER COMMISSIONER Bell Forest 4560
ASSESSMENT SECTION Bell Main 5580 57q 31 Kinloch Central 3840 57q 57 Municipal Phone	S.E.P. SECTION Bell Colfax 716 Kinloch Central 154 Municipal Phone	ENGINE ROOM Night Extensions of Bell Colfax 655 Kinloch Central 153	ENGINE ROOM Night Extensions of Bell Colfax 521 Kinloch Central 152-L	PIPE YARD Bell Grand 422 Kinloch Victor 37 Municipal Phone	GATE HOUSE Bell Grand 4766 Municipal Phone	F.T. CUTTS, Asst. WATER COMM. Bell Cahany 925
DISTRIBUTION SECTION Bell Main 5580 57q 13 Kinloch Central 3840 57q 40 Municipal Phone	STORE ROOM Bell Colfax 1360 Municipal Phone	PASSENGER STATION Bell Colfax 28	CHEMICAL LABORATORY Bell Colfax 640	OSAGE STREET Kinloch Victor 1471 Municipal Phone	SANITARIUM	C.A. CHENEY, SECRETARY Bell Cahany 5072
METER & TAP BRANCH Kinloch Central 3840 57q 53 Municipal Phone	OPERATING SECTION Bell Colfax 1320 Kinloch Ex Central 154 Municipal Phone	ELECTRICAL SHOP Railway Station Bell Colfax 381	COAGULANT HOUSE Extension of Bell Colfax 640	NATURAL BRIDGE Kinloch Delmar 2656 Municipal Phone	SANITARIUM PUMPING STATION Bell Grand 5367 Municipal Phone	C.M. DAILY, ENGR. IN CHARGE S&P Bell Grand 2621-J
INSPECTION BRANCH Kinloch Central 4321 Night - Bell Main 5580 57q 13 Municipal Phone	ENGINE HOUSE No. 1 Night Extension of Bell Colfax 1320 Municipal Phone	GREEN HOUSE Call Button from Office Bell Colfax 655 Kinloch Central 153	FILTER PLANT Bell Colfax 1520	CHESTNUT STREET Kinloch Central 4690 Municipal Phone		FR. WIEDEHOLT, Asst. ENGR. S&P Bell Cahany 4413
				MAY STREET Kinloch Central 1533 Municipal Phone		A.W. MAGEE, ELECTRICIAN S&P Bell Forest 3952
						C.W. MELVILLE, FOREMAN S&P Bell Colfax 1276
						L.A. DAY, ENGR. IN CHARGE O.S. Kinloch Delmar 3521-R
						K. TOENSELDT, Asst. ENGR. O.S. Bell Grand 5711-M
						H. BERGER, ENGR. BISSELL'S POINT Bell Colfax 436-J
						G. HOFFMAN, ENGR. BADEN Bell Colfax 2064
						J. SCHMIDT, ENGR. CHAIN OF ROCKS Bell Colfax 725-W
						L. CHIVVIS, ENGR. IN CHARGE DIST. SEC. Bell Lindell 6178-R
						W.A. FOLEY, Asst. ENGR. DIST. SEC. Kinloch Delmar 3942-L
						MAX THIELLE, FOREMAN DIST. SEC. Bell Lindell 4396-W
						J.M. SULLIVAN, FOREMAN Bell Lindell 4396-R

# ORGANIZATION

OF THE

## ST. LOUIS WATER DIVISION

---

EDWARD E. WALL, Water Commissioner  
FRANCIS T. CUTTS, Assistant Water Commissioner  
CHAS. A. CHENEY, Secretary

### SUPPLY AND PURIFYING SECTION

CORNELIUS M. DAILY, Engineer in Charge  
AUG. V. GRAF, Chemist

### OPERATING SECTION

LEONARD A. DAY, Chief Mechanical Engineer  
K. TOENSFELDT, Engineer in Charge Construction

### DISTRIBUTION SECTION

WM. A. FOLEY, Principal Assistant Engineer in Charge

### ASSESSMENT SECTION

WILLIAM T. KIRCHEIS, Supervisor



ANNUAL REPORT  
OF THE  
WATER COMMISSIONER  
OF THE  
CITY OF ST. LOUIS

FOR THE YEAR ENDING APRIL 1ST, 1918

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OFFICE OF THE WATER COMMISSIONER,  
June 1st, 1918.

HONORABLE JAMES A. HOOKE,  
Director of Public Utilities, City of St. Louis, Mo.

DEAR SIR: The following report of the activities of the Water Division during the year ending April 1st, 1918, is respectfully submitted for your consideration and information and for transmission to the Board of Public Service, as required by Section 10, Article VIII, of the Charter of the City of St. Louis.

The total expenditures from waterworks funds during the year just past amounted to \$2,514,831.07, of which only \$1,393,363.36 can be legitimately charged to the expense of operation and maintenance of the waterworks, \$577,161.80 being expended in additions, betterments and extensions, \$99,675.31 for work done for other departments at the expense of the Water Division, \$42,908.10 for war protection, and \$401,722.50 for interest on outstanding bonds and sinking fund set aside for redemption of same.

The net expenditure for operation and maintenance for the year 1917-18 was \$261,845.62 greater than in 1916-17. This increase is due to higher prices paid for labor, supplies and materials of all kinds.

Had it been possible to obtain these essentials at the prices of 1916, the expenditure in 1917-18 for operation and maintenance only, would have been reduced by at least \$275,000.00, comparative figures of the principal items being shown on pages 19-20. These figures are

cited merely to show that the continually increasing total expenditures for each year are due to no extravagance or inefficiency in the management of the Water Division, but are the logical results of existing abnormal conditions.

Immediately after the United States entered into the war, Company I, First Regiment, of the National Guard of Missouri, was quartered at the waterworks and orders issued to establish sentry posts and patrols covering all points where damage could be readily inflicted. As soon as the materials could be purchased, all pumping stations were surrounded with a barbed wire fence, seven feet high, with all entrances guarded by special officers, who allowed no one to pass in or out without identification. Everyone, employes included, was given a special badge on entering the premises, which he was obliged to surrender as he passed out the gate. Under date of July 16th, 1917, the Governors of the several States were notified by the Adjutant General of the Central Department, United States Army, that the troops would be withdrawn on August 1st from guarding manufacturing plants, waterworks, elevators, mills, warehouses, etc., and advising that the owners or heads of utilities would have to look to State and municipal governments for protection.

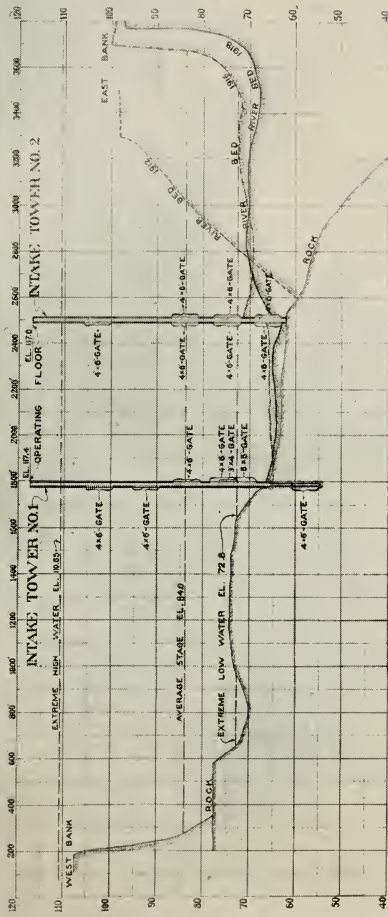
Accordingly, the Water Commissioner organized and employed a force of special officers, composed of sixty men, armed with Winchester riot guns, who were divided into three squads, each officered by a foreman or sergeant.

This guard has been maintained throughout the fiscal year, and will no doubt be continued for some time as a precautionary measure. Information as to the maintenance, reduction or removal of guards at various waterworks throughout the country has been asked for, and the replies received will no doubt affect the policy of this city as to future guarding of the works.

New construction has been mainly confined to the prosecution of work on existing contracts, the only contracts of consequence that were let during the year being those for cleaning water mains and for the reconstruction of the Baden Station steam plant.

On April 1st, 1918, there had been cleaned a total of over fifty miles of 6-inch, 12-inch and 20-inch mains, all of which were laid more than twenty-five years ago. A detailed account of the amount of incrustation, mud, etc., removed from these mains will be found farther on in this report. Tests showed that the carrying capacity of these mains was from 85 to 93 per cent greater after cleaning.





CROSS-SECTION OF MISSISSIPPI RIVER ON LINE A-B-C-D  
SCALE - VERT. 1" = 20' ; HOR. 1" = 160'



MAP OF MISSISSIPPI RIVER SHOWING LOCATION OF CROSS-SECTION  
SCALE 1" = 160'

SUPPLY & PURIFYING SECTION  
ST. LOUIS WATER WORKS  
CROSS-SECTION OF MISSISSIPPI RIVER AT CHAIN OF ROCKS  
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CHECKED BY: [blank]  
APPROVED BY: [blank]  
SCALE: AS SHOWN  
3920 DRAWER 10

An appropriation for the continuance of this work will be asked for, so that the filtered water may eventually be delivered to consumers through clean pipes.

Contracts for the reconstruction of the Baden steam plant were let in December, 1917, and the work has been progressing rather slowly, due to the scarcity of labor and to the difficulty of obtaining materials. As this plant must be rebuilt while it is in service, it can only be wrecked and reconstructed in sections, keeping not less than six boilers ready for use all of the time. This necessarily means some delay as well as slow progress and comparatively high cost. It is expected that the entire reconstruction will be completed in 1919.

Nine thousand five hundred feet of the new reinforced concrete conduit between Baden and Bissell's Point has been finished, leaving 5744 feet still to be done, which, at the present slow rate of building, will hardly be completed during the calendar year 1918. At times it has been practically impossible to employ labor or secure material on this work, obliging the contractor to lose much favorable weather for outdoor construction.

The construction of four hurdle dikes was attended with the same difficulties and delays from similar causes and also on account of the high stage of the river early in 1917 and the long period of extreme cold weather in the past winter.

The contractor exercised due diligence in prosecuting his work at all times when men and materials were available and when river and weather conditions were favorable, so that a comparatively small amount of work remains to be done, which will probably be completed by June 1st, 1918.

The anticipated results from the construction of these dikes have already begun to appear in the formation of sand bars between and below the dikes next to the Illinois shore, and also in the scouring away of the sand deposit at the east intake tower. From all appearances the channel will be restored to the limits it occupied in 1914, when the location of the new intake tower was selected and when the bedrock was swept bare of sand by the current.

Every effort was made to hasten the completion of the 100-million-gallon centrifugal pump in the De Laval shops at Trenton, N. J., so that it might be installed at the Chain of Rocks before June 1st, 1918, in order to meet the heavy consumption of the summer months. Two trips to the shops were made by the Water Commissioner and one by the Chief Mechanical Engineer in the endeavor to secure priority over

other work. While it turned out to be impossible to obtain precedence over other orders sufficient to insure delivery of the unit by June 1st, yet these visits were successful in advancing the shop work so that the shop test is promised for June 15th, after which shipment will be made at once. This unit should arrive in St. Louis by July 15th, but the work of installing it will hardly be commenced before September, because the summer consumption may require the service of all engines and it would be hazardous to interrupt the normal operation of the station with the changes necessary for the installation of the new unit.

Considering the fact that at the usually low winter stage of the river the total daily pumping capacity of the station at present does not exceed 180 million gallons, the increase of 5.5 million gallons in the average daily pumping at the Chain of Rocks Station during 1917-18 over the figures of 1916-17 points significantly to the need of additional capacity, and the record maximum pumping for one day (January 13th, 1918) of 163.1 million gallons, taken with the daily average of 129.5 million gallons for the month of January, 1918, gives a distinct warning that the purchase and installation of the new pump has not been in any sense unnecessary or premature.

The delivery of the valves and special castings for the double 48-inch manifold, contracts for which were let in September, 1917, was delayed until it was too late to begin actual construction in time for completion before the summer season, so that the work of tearing out the old by-passes and installing the manifolds will not be commenced until October.

It is hardly probable that improvements or extensions of any magnitude will be started this year, on account of the labor and market conditions. The necessity for covering the storage basins at Baden and Bissell's Point is just as great today as it was three years ago, just after the filters were put in service. Every year the Water Commissioner has urgently recommended that these basins be covered, and has, with the approval of the Board of Public Service, introduced bills appropriating money for this purpose, only to see the recommendations ignored and the bills pigeon-holed. Now, the conditions brought about by the Great War practically prohibit this sort of construction by contract, and it is doubtful if the City could procure the equipment and materials and secure the labor necessary to complete the work in any reasonable time and without incurring an excessive cost. It will therefore be necessary to continue the unsanitary practice of exposing the pure filtered water to contamination in open basins, and to waste millions of gallons of water each summer in draining the basins every

time the growth of algae and the presence of macroscopic organisms reaches the unbearable point. Comment on the folly and absurdity of a policy which has allowed such a condition of affairs to develop and continue would be superfluous. A very complete, plain and interesting account of the causes, resulting conditions and applied remedies will be found in the Chemist's Report on pages 53-67.

In clarifying 39,317 million gallons of river water, 329,300 tons of dissolved and suspended matter was removed, being an average of almost eight and a half tons to the million gallons, approximately one pound to each fifty gallons of water pumped from the river.

By the removal of the dissolved matter from the river water, its hardness was reduced from the average of 190 parts per million to 106 parts per million, thus lowering the quantity of soap required in water used for washing purposes from one pound of soap to every twenty-five gallons to one pound for every forty-three gallons.

This means a total saving of about 12,600 pounds of soap per day to the people of St. Louis, assuming that an average of one gallon of water per person per day is used for washing purposes, which is a very conservative estimate. The value of this quantity of soap, calculated at the wholesale price of laundry soap, viz., ten cents per pound, is more than one and one-half times the total daily cost of clarifying, softening, purifying and filtering the water. This is only one of the benefits accruing to the people of St. Louis arising from the treatment of the water supply, and as this alone far overpays the cost of treatment, all other advantages, such as improvement in the public health, reduced death rates, increased comfort and pleasure because of the knowledge of a safe water supply, and the satisfaction derived from the use of water attractive to the eye and agreeable to the taste, may be looked upon as clear profit, demonstrating the incalculable value of the new water supply over the old.

The average daily consumption of 104,345,000 gallons for the year ending April 1st, 1918, shows an increase of 6,700,000 gallons over that of the preceding year. This means that the daily per capita consumption for 1917-18 was 136.4 gallons as compared to 130 gallons for 1916-17, these figures being based on an estimated population of 765,000 and 750,000 respectively.

The average daily consumption of the past year, after allowing a reasonable normal increase over the figures of 1916-17 on account of the growth of the City, still shows an inexcusable waste and an

intemperate use of water, particularly during the hot and dry summer months and throughout the periods of excessive cold weather of the winter.

From June 18th to August 31st, inclusive, the average daily consumption was 115,900,000 gallons with a maximum of 134,600,000 on July 30th, and one period of seven days, July 28th to August 3d, inclusive, with an average of 123,700,000 per day.

The record for the winter months shows a period of forty-three days, December 28th to February 8th, inclusive, for which the average daily consumption was 126,400,000 gallons. During this entire forty-three days the weather was extremely cold, the thermometer on one day reaching  $-17^{\circ}$  F. No water could be used for street sprinkling, street washing, in the public parks, on private lawns or gardens, or any of the other uses and abuses common to the summer season, when consumption figures climb to the maximum, so that this cold weather average of 126,400,000 gallons per day with its maximum consumption of 156,500,000 represents the waste of water carried to the extreme limit.

As a striking example of the moral obliquity of property owners and agents regarding waste which does not directly and immediately cost them anything, the following is an exact copy of a notice printed in large type and sent out last winter by a real estate company doing a large business in St. Louis:

#### **TENANTS.**

Owing to the extremely high cost of Plumbing Repairs, tenants are kindly requested to protect the plumbing and use every possible precaution to avoid water pipes freezing during the winter months.

Faithfully complying to the above will save **YOU** considerable annoyance and the owner a great deal of expense.

No details as to "every possible precaution" are given, but it is plainly an invitation to open the faucets and let the water waste, in order to "protect the plumbing," and no doubt was so understood by the tenants. This sort of public advice at a time when the United States Government was exerting every effort to save coal, comes very near being a disloyal act, although it is probable that the sponsors of the above notice did not realize that such an interpretation might be placed upon it.

The quantity of water used in the winter time should be no greater than the normal consumption during moderately cold weather in November or March, which in 1917 was about 92,000,000 gallons daily.

This quantity will not only provide an ample supply for all legitimate uses of water, but takes into account excessive extravagance and waste probably amounting to 25 per cent of the total.

In other words, with an average daily per capita use of about 90 gallons, which is more than is used in Minneapolis, Providence, Atlanta, Columbus, Kansas City, New Orleans, Omaha and other cities fully metered, the annual average daily consumption of St. Louis would normally be less than 75,000,000 gallons.

It is safe to say, that, on a conservative estimate, at least 20,000,000 gallons of water are daily pumped into the mains and carelessly wasted into the sewers and drains without having served any useful purpose. Many people believe and it has been often stated in the public press that the extravagant use of water serves to flush out the sewers and thus improves the sanitary condition of the community. This statement has often been used as an argument against the installation of meters, but a little consideration will show its absurdity. The flow necessary to accomplish any flushing of consequence would require a depth of at least four inches in the sewers with a velocity of two feet per second. All house drains in St. Louis connect to lateral sewers twelve inches or more in diameter. The quantity of water necessary to produce the above flow in each of these twelve-inch lateral sewers would approximate 300,000 gallons per day, which would have to be supplied at the upper end of each lateral sewer. There are usually less than fifty houses connected to the upper 800 feet of these sewers. Assuming that fifty houses are inhabited by 250 persons, the daily per capita use of water to provide the 300,000 gallons necessary for adequate flushing would be 1,200 gallons, which is almost nine times the actual average daily per capita for the year 1917-18. That is to say, all of the pumps in the waterworks, operated at full speed, could furnish but little more than one-ninth of the water necessary to flush the sewer system to a very limited extent. In all probability the actual normal dry weather flow in each of these sewers does not exceed 20,000 gallons per day. A continuous rainfall of one-tenth of an inch per hour over the area drained by the upper 800 feet of these lateral sewers would be equivalent in quantity to the flow above specified necessary for flushing the sewers. An ordinary rainfall of one-half inch or three-quarters of an inch in an hour would do more good in flushing out sewers than

all the water pumped by the waterworks in a week, even if it all could be discharged into the sewers of St. Louis within two hours.

Obviously, the most extravagant waste of water could have only an infinitesimal effect in flushing out the sewer system or in keeping it in a sanitary condition.

But the continuous daily waste of 20,000,000 gallons of water is far from an insignificant item, when it is remembered that for each million gallons of water pumped in 1917-18, 3,254 pounds of coal was consumed, or a total of 11,877 tons in pumping the preventable daily waste during the entire year.

This amount of coal would supply at least 1,000 ordinary homes with enough fuel to last them throughout the year. The chemicals alone used in purifying this 20,000,000 gallons wasted daily cost about \$40,000.00 during the year 1917-18.

The above figures show only the two major items of the total amount that the people of St. Louis are paying for the privilege of an unrestricted use of water. Taking all of the items of cost of operation and maintenance, for assessing and collecting the rates, for interest and sinking fund, for extensions and improvements, for miscellaneous expenses, and averaging these costs from actual figures taken over a period of years, prior to the great advance in prices of the last year or so, we find the average cost per million gallons delivered to the consumer to be about \$80.00. Twenty million gallons of water wasted daily means an annual loss of \$584,000.00, calculated at pre-war prices. At present costs the loss would be at least one-third more. These figures, large as they are, do not represent all the loss to the community resulting from water waste. The increased cost incurred by reason of the requirement for greater pumping capacity and larger mains, conduits, storage basins, etc., than that necessary to supply all reasonable uses of water, and the hastening of the time when the present waterworks will be inadequate and new works will have to be built, is the greater question to be considered, and one which will eventually involve the expenditure of millions.

While it is inevitable that the time must come when the present works will have to be supplemented by additional works, that time can be postponed many years by a proper conservation of the present supply through the enforcement of measures prohibiting all abuses of water privileges and requiring and regulating its temperate use.

The first step to be taken in this direction is the adoption of the policy of universal metering of all services, and providing ways and

means for the installation of over 100,000 meters to be completed at least in five years and if possible in three. There is no longer any rational ground for argument over the wisdom of measuring water supplied to consumers. That question is now practically settled, and the opponents of universal metering will soon find themselves relegated to the class of people who are opposed to telephones, automobiles, aeroplanes and other innovations. It will probably not be very long until the United States Government will order general meter installation in all unmetered cities as a conservation measure.

The constantly increasing consumption compels regular additions to the number of pumping units and the consequent extensions and enlargements of the purification and distribution systems. This naturally must be the case in a growing city, regardless of the question of the waste of water, which enters into the case only as one of the prime factors continually hastening the time when each addition to the general capacity becomes necessary.

Graphical representations of past, present and probable future conditions of the relations between consumption and pumping capacity are shown on the charts accompanying the report of the Chief Mechanical Engineer, accompanied by a full discussion in the text. The case is very clearly stated and the conclusion inevitable that another pumping unit should be installed in High Service Station No. 2 before 1920. In normal times this unit would consist of a 20-million-gallon triple expansion pumping engine, costing about \$120,000.00, but at present such an engine, if it could be contracted for at all, is estimated to cost \$450,000.00.

Under these circumstances, it is recommended that a steam-turbine-driven multi-stage centrifugal pump be installed at a probable cost of \$100,000.00. After the war, should prices drop to a more reasonable basis, this centrifugal pump can be profitably moved to Low Service Station, Chain of Rocks, and a triple expansion engine be installed in its place at High Service Station No. 2. An appropriation for purchasing and installing the centrifugal pump will be asked for before the close of the year.

After intermittent discussions extending over the whole fiscal year of 1917-18, the Board of Aldermen passed the bill providing rules, regulations and rates for the use of water, which was drawn up and submitted by the Water Commissioner in May, 1917.

This bill abolished the system of refunding, on account of partial vacancies, a portion of the license paid in advance, a practice which was

productive of innumerable disputes between the Assessment office and the public, and which added considerably to the amount and complexity of the clerical work. As far as practicable, the flat rates were adjusted to a more equitable basis and lowered in many cases.

The sliding scale of general meter rates was amended so as to require but twelve items in the ranges of prices per 100 cubic feet, instead of the one hundred and eleven items of the old schedule. The actual bills rendered the consumer under the two schedules are practically the same.

Special meter rates were continued to manufacturers, charitable institutions, public schools and swimming pools, the rate to manufacturers being slightly increased.

The new schedule of rates will probably reduce the annual revenue to some extent, but how much can not be predicted.

At the time the bill was drafted it was not thought advisable to increase rates to provide more revenue, as it was hoped that conditions would become more stable and prices in general tend to decline. But shortly afterward the United States entered into the Great War, and the prices of everything, including labor, began to advance rapidly. Long before the bill was passed and became effective, it was evident that the costs of operation and maintenance, interest and sinking fund charges, and the unavoidable extensions and betterments, would absorb the entire revenue, leaving no surplus for completing the general plan for bringing the waterworks to its maximum daily capacity of 160,000,000 gallons, as outlined in the Water Commissioner's report for 1916-17. The work remaining to be done to bring the works to its maximum capacity is composed of the following items:

	Estimated in 1916-17	Cost at present
Covering Storage Basins at Bissell's Point.	\$ 600,000.00	\$ 750,000.00
Covering Storage Basins at Baden.....	150,000.00	200,000.00
One 20 M. G. Centrifugal.....	75,000.00	100,000.00
One 36-inch Pump Main, 5 miles long...	400,000.00	650,000.00
One 100-million-gallon storage basin at Baden .....	1,000,000.00	1,300,000.00
	<u>\$2,225,000.00</u>	<u>\$3,000,000.00</u>

The above estimate does not include provision for the installation of permanent pumps at Bissell's Point, but only for one centrifugal,

which would be installed at the present time, on account of its comparatively low first cost. At prices prevailing in normal times, two triple expansion pumps would cost at least \$300,000, so that the above totals should be increased by that amount.

Although under present conditions it is not possible to purchase machinery and materials and employ labor to execute the improvements and extensions above listed, and although it is apparently not necessary to have a surplus annually accumulating over and above the necessary expenditures, since such surplus can not be economically used, yet it should be remembered that the need of additional capacity is growing greater each year, and regardless of conditions or prices, the time is not far distant when it will be imperatively necessary to proceed with these betterments and extensions. This being true, it would be preferable to increase the rates sufficiently to provide an annual surplus large enough to meet these expenditures when the improvements can no longer be postponed, rather than to be forced to issue bonds for waterworks extensions at a time when the market is likely to be flooded with bond issues, and also at the same time that the City will be compelled to provide funds for the construction of new waterworks to augment its water supply. The Water Commissioner would recommend an increase in rates sufficient to add at least 25 per cent to the net annual revenue.

Because of the increase in number and in working hours of factories in general and the consequent greater use of water by them as well as by other industries stimulated by the demand for war supplies and munitions, the necessity for action in regard to the adoption of a general plan for new and additional waterworks to supplement the ultimate supply possible to be obtained through the present works, is more urgent than at any previous time since 1912, when the Water Commissioner first submitted a full report on the water supply of the City of St. Louis, showing that the present works would be adequate for the needs of the City no longer than 1926. This estimate was based on the continuance of normal conditions and growth, which is far removed from the present state of affairs. Present indications are that the average daily consumption of water for 1918-19 will far exceed that of 1917-18, and that the use of water will increase far more rapidly than shown in the estimates submitted in 1912 and again in 1915. The few years intervening between now and the date when new waterworks are needed, will pass so quickly that the emergency will be upon us before we are aware, and the fiscal year of 1918-19 should not close without some action being taken by the Board of

Public Service leading to the adoption of a general plan for locating and building new waterworks.

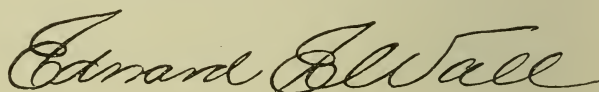
Notwithstanding the loss of several of the most efficient and valuable employes of the division, who have entered the Government service, the general work of operation, maintenance and betterment has proceeded with the usual dispatch and economy. This has been possible because of the fact that much of the new work has been completed and numerous projects have been curtailed or postponed.

The Water Division is justly proud of its members who are serving the country in the Great War, knowing that each and every one of them will do his full duty there as he did with us.

Reports from the various heads of the sections and branches of the division, giving in detail the amount and character of the work in each case, will be found in the body of this report.

The maintenance of the high standard of service to the public is due to the careful, faithful and intelligent work of the engineers, superintendents and employes of the waterworks.

Respectfully submitted,

A handwritten signature in cursive script, reading "Edward E. Wall". The signature is written in dark ink and is positioned above the printed name of the Water Commissioner.

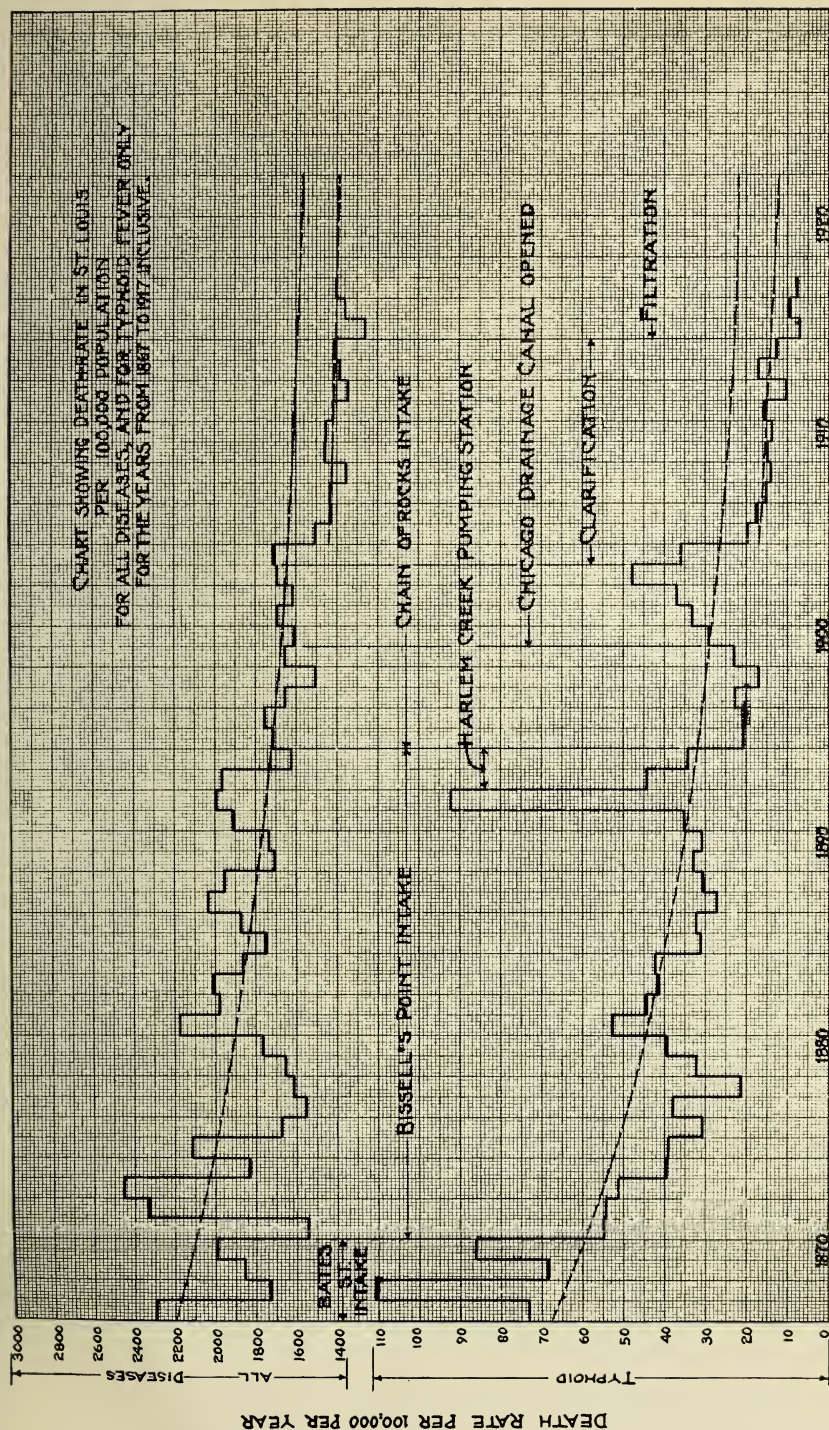
Water Commissioner.



TABLE No. 2.  
MORTALITY TABLE FOR ST. LOUIS.

CALENDAR YEAR	Population	Deaths from all Diseases	Cases of Typhoid	Deaths from Typhoid	Death Rate per Year per 100,000 from	
					All Diseases	Typhoid
1900.....	575,000	9215	1213	168	1603	29.22
1901.....	586,500	9916	1052	198	1690	33.76
1902.....	598,000	9654	1112	222	1614	37.12
1903.....	609,500	10320	1586	287	1693	47.09
1904.....	621,000	10635	872	225	1722	36.23
1905.....	632,500	9545	672	120	1509	18.97
1906.....	644,000	9214	608	112	1431	17.40
1907.....	655,500	9480	568	102	1446	15.56
1908.....	667,000	9076	684	95	1360	14.24
1909.....	678,500	9963	661	101	1460	14.88
1910.....	689,000	9972	681	95	1447	13.78
1911.....	700,000	9862	586	108	1409	15.43
1912.....	711,000	9680	517	74	1361	10.41
1913.....	722,000	9960	800	122	1380	16.89
1914.....	732,000	10252	471	91	1400	12.43
1915.....	740,000	9388	306	52	1260	7.00
1916.....	752,000	10220	580	71	1359	9.44
1917.....	765,000	10724	509	58	1402	7.58

CHART SHOWING DEATH RATE IN ST. LOUIS  
PER 100,000 POPULATION  
FOR ALL DISEASES, AND FOR TYPHOID FEVER ONLY  
FOR THE YEARS FROM 1887 TO 1917 INCLUSIVE.



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**TABLE No. 3.**  
**COMPARISON OF PAY ROLLS.—1916 AND 1917.**

SECTION	Number of Employees October, 1916	Total Wages Paid October, 1916	Number of Employees October, 1917	Total Wages Paid October, 1917
Commissioner's Office.....	11	\$ 1,648.34	11	\$ 1,507.47
Assistant Commissioner.....			16	1,650.65
Distribution.....	254	16,243.27	267	19,038.98
Baden.....	91	6,821.99	90	8,152.38
Bissell's Point.....	93	6,924.47	84	7,816.54
Chain of Rocks.....	76	5,672.82	76	6,856.46
Sanitarium.....	39	2,743.46	39	3,451.01
Meter and Tap.....	23	1,594.52	28	2,266.81
Inspection.....	45	3,072.00	48	3,633.39
Construction.....	9	964.11	6	1,004.17
Supply and Purifying.....	241	18,045.95	239	19,678.50
Assessment.....	53	4,789.70	53	5,174.94
Totals.....	935	\$68,520.63	957	\$80,231.30

Average Monthly Salary, 1916 = \$73.28.  
Average Monthly Salary, 1917 = 83.84.

**TABLE No. 4.**  
**COMPARISON OF PAY ROLLS.—1917 AND 1918.**

SECTION	Number of Employees March, 1917	Total Wages Paid March, 1917	Number of Employees March, 1918	Total Wages Paid March, 1918
Commissioner's Office.....	11	\$ 1,668.34	10	\$ 1,476.66
Assistant Commissioner.....			16	1,649.92
Distribution.....	291	18,726.69	263	18,909.62
Baden.....	88	7,773.18	85	7,649.79
Bissell's Point.....	87	7,455.00	83	7,619.50
Chain of Rocks.....	76	6,590.58	77	7,072.01
Sanitarium.....	39	3,217.40	41	3,503.29
Meter and Tap.....	24	1,872.50	23	1,861.00
Inspection.....	44	2,991.47	48	3,660.00
Construction.....	10	1,135.00	7	1,093.33
Supply and Purifying.....	266	19,844.69	234	19,036.09
Assessment.....	52	4,804.70	53	5,218.33
Totals.....	988	\$76,079.55	940	\$78,749.54

Average Monthly Salary, 1917 = \$77.00.  
Average Monthly Salary, 1918 = 83.77.

**WAGES PAID.**

October, 1916. . . . . Average = \$73.28.  
March, 1917. . . . . Average = 77.00.  
October, 1917. . . . . Average = 83.84.  
March, 1918. . . . . Average = 83.77.

1916-17 = \$75.14.  
1917-18 = 83.80.

Difference \$8.66.

**TABLE No. 5.**  
**INCREASE IN PRICES OF SOME MATERIALS**  
**AND SUPPLIES.**

	1918	Cost, 1918	Cost at 1916-17 Prices
Coal.....	90,366 tons	\$230,009.89	\$144,378.10
Lime.....	15,608 tons	124,864.00	76,947.44
Sulphate of Iron.....	1,636 tons	25,865.16	23,263.92
Alum.....	1,922 tons	48,857.24	43,667.84
Cement.....	3,280 barrels	8,036.00	5,412.00
Cylinder Oil.....	9,860 gallons	5,620.20	3,007.30
Engine Oil.....	4,880 gallons	1,137.04	819.84
Hay.....	142 tons	4,742.80	3,223.40
Oats.....	9,000 bushels	10,080.00	6,198.75
Pig Lead.....	45 tons.	8,100.00	6,241.50
		\$467,312.33	\$313,160.09
		313,160.09	
Increase.....		\$154,152.24	

NOTE.—The total sum of \$642,685.29 was expended in 1917-18 for materials and supplies used in the maintenance and operation of the Water Works.

The cost of all materials and supplies, including those listed above, figured at 1916-17 prices, would undoubtedly show the total increase to be more than \$175,000.00.

## YEARLY FLAT RATE SCHEDULE.

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Amusement parlor.....	\$10.00
Apartment house, tenement, flat or rooming house, per room....	.90
Automobile .....	2.00
Aquarium, indoor, supplied with running water, allowed only where premises are metered.	
Aquarium of fish pond, outdoors, allowed only where premises are metered.	
Bakery, three hands or less.....	10.00
For each additional hand.....	2.80
Barber shop, first chair.....	5.00
For each additional chair.....	2.00
Bath in private residence, tenement, rooming house, apartment house or flat.....	2.00
All others.....	5.00
Beer pumps.....	20.00
Billiard or pool hall, for two tables or less.....	3.00
For each additional table.....	1.00
(One billiard or pool table allowed without extra charge in dramshop, saloon or club room.)	
Book bindery, six hands or less.....	10.00
For each additional hand.....	1.50
Bowling alley, first pair of alleys.....	3.00
For each additional alley.....	1.00
(One bowling alley allowed without extra charge in dram- shop, saloon or club room.)	
Buggy .....	2.00
Building Purposes:	
Brick masonry, per thousand brick.....	.09
Concrete, per hundred cubic feet.....	.20
Conduit masonry, per hundred cubic feet.....	.16
Granitoid, per hundred square feet.....	.05
Hollow tile, per hundred square feet.....	.05
Plastering, per hundred square feet.....	.05
Stone masonry, per hundred cubic feet.....	.16
Street paving, per hundred square feet.....	.10

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**YEARLY FLAT RATE SCHEDULE—Continued.**


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Confectionery and candy manufactory, three hands or less....	\$10.00
For each additional hand.....	2.80
Carriages .....	2.00
Church, chapel or mission.....	\$5.00 to 20.00
Cigar and tobacco manufactory, three hands or less.....	3.50
For each additional hand.....	1.00
Club room.....	\$5.00 to 20.00
Coffee or tea room, twenty chairs or less.....	5.00
For each additional chair.....	.20
Coffee roasting, per oven.....	5.00
Cow .....	3.00
(Dairies having more than five cows to be metered.)	
Dental office, in addition to office charge, for each fountain cuspidor .....	10.00
Dramshop, with not more than two bartenders.....	20.00
For each additional bartender.....	8.00
Additional charge where hot lunch is served.....	5.00
Dyeing and cleaning establishment, three hands or less.....	10.00
For each additional hand.....	2.80
Filling cistern, per hundred gallons.....	.05
(Minimum charge, \$1.00.)	
(Fountains allowed only where premises are metered.)	
Gas engine or air compressor, tank cooled, per H. P.....	.40
(Minimum bill, \$1.00.)	
Cooled direct, per H. P.....	3.00
Hall or assembly room, superficial floor area 1,500 square feet or less.....	5.00
For each additional 500 square feet or fraction thereof.....	1.50
Lat factory, three hands or less.....	5.00
For each additional hand.....	1.50
Horse .....	3.00
Hotel, per room.....	1.00
Hotheds, hothouse or greenhouse, per 100 square feet.....	.50
Hose, in livery stable, sales stable, public garage having five vehicles or less.....	10.00
For each additional vehicle.....	1.80
Hose, the use of water by hose or otherwise for sanitary pur- poses in dairies (stables having five cows or less).....	12.00

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**YEARLY FLAT RATE SCHEDULE—Continued.**

Hose, on all other premises having a frontage of twenty-five feet or less.....	\$ 1.00
For each additional front foot.....	.04
The entire frontage of premises shall be assessed for hose permit, provided a hose is found on the premises, together with a hose bibb or other plumbing fixture to which hose may be attached. Premises having a system of pipes installed for sprinkling will be charged double the rate established for the use of hose.	
Ice cream parlor, twenty chairs or less.....	5.00
For each additional chair.....	.20
Ice cream manufactory, three hands or less.....	10.00
For each additional hand.....	2.80
Laboratory, two hands or less.....	25.00
For each additional hand.....	10.00
Lace curtain laundry, two hands or less.....	10.00
For each additional hand.....	4.00
Laundry, three hands or less.....	40.00
For each additional hand.....	5.00
Livery or sales stable, ten stalls or less.....	20.00
For each additional stall.....	1.80
Lunch stand without chairs, stools or tables.....	8.00
Lunch room, forty chairs or less.....	18.00
For each additional chair.....	.40
Manufacturing establishment, six hands or less.....	12.00
For each additional hand.....	1.80
Milk depot, exclusive of charge for bottle washing.....	10.00
(Sterilizing apparatus allowed only where premises are metered.)	
Minnow or fish tank, capacity 100 cubic feet or less.....	10.00
For each additional 100 cubic feet or fraction thereof.....	8.00
Mule .....	3.00
Nursery, superficial area 2,500 square feet or less.....	2.00
For each additional 1,000 square feet or fraction thereof....	.60
Office, superficial area 300 square feet or less.....	3.00
For each additional 100 square feet or fraction thereof.....	.80
Photograph gallery on one floor with one dark room.....	20.00
For each additional floor.....	16.00
Printing office, six hands or less.....	12.00
For each additional hand.....	1.80

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**YEARLY FLAT RATE SCHEDULE—Continued.**


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Residences occupied by one family, three rooms or less.....	\$ 2.00
For each additional room.....	.70
(Reception halls, sun parlors, enclosed porches and alcoves containing not more than 120 square feet superficial area shall not be considered as rooms.)	
Restaurant, forty chairs or less.....	18.00
For each additional chair.....	.40
Saloon with not more than two bartenders.....	20.00
For each additional bartender.....	8.00
Additional charge when hot lunch is served.....	5.00
School, having twenty-five pupils or less.....	2.00
For each additional pupil.....	.05
Shop, superficial floor area 300 square feet or less.....	3.00
For each additional 100 square feet or fraction thereof.....	.80
Slaughter house, three hands or less.....	20.00
For each additional hand.....	6.00
Soda fountain, where ice cream and syrups are served.....	5.00
(No allowance made for winter months.)	
(Where wash box is supplied with a continuous stream of water, premises to be metered.)	
Soda or carbonated water manufactory allowed only where premises are metered.	
Spring wagon.....	2.00
Sprinkling streets with sprinkling carts, for each 100 square feet superficial area.....	8.00
Steam boiler, stationary, per square foot of heating surface....	.40
Heating surface to be computed on the area of the boiler and flues exposed to the fire. A statement of the dimensions, construction and the Boiler Inspector's number of each boiler shall be filed at the time of application for water permit. A proportionate allowance shall be made on each boiler that is used only a portion of the time, the applicant being required to make affidavit as to the actual running time. The full rate of 40c per square foot of heating surface is based on ten hours' operation per day for 300 days per year. Steam boilers, portable traction, 300 days per year.	
Steam boilers, portable traction engines, graders, steam shovels, hoisting engines, pile drivers, etc.....	25.00
(No refund allowed, no permit issued for less than one year.) Applicant must furnish Boiler Inspector's number.	

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**YEARLY FLAT RATE SCHEDULE—Continued.**

Sand blast apparatus or vacuum cleaner, operated by gas engine, per H. P. ....	\$ 3.00
No refund allowed.	
Store, superficial area, 300 square feet or less. ....	3.00
For each additional 100 square feet or fraction thereof. ....	.80
Tannery, three vats or less. ....	20.00
For each additional vat. ....	6.00
Urinal basin or trough. ....	15.00
Sinks in toilet rooms where there is no urinal basin will be charged for as urinal basins where they are not over, 36 inches above the floor.	
Vats, boiling or pickling. ....	6.00
Warehouse or storehouse, superficial floor area 3,000 square feet or less. ....	5.00
For each additional 1,000 square feet or fraction thereof. ....	1.50
Washing bottles, three hands or less. ....	10.00
For each additional hand. ....	2.80
Washing meats, three hands or less. ....	10.00
For each additional hand. ....	2.80
Water closet in hotel, waiting room, saloon, winerom. ....	5.00
All others. ....	3.00
Water motor washing machine. ....	3.00

For the use of water for any purpose not herein specifically designated and not paid for at meter rates, the charge shall be fixed by the Water Commissioner, and shall not be less than \$1.00 nor more than \$1,000.00. No charge will be made for vehicles in a livery stable or public garage where hose permit is taken out. All permits for sprinkling streets, lawns and for hose assessed at frontage rates shall date from the first day of April and be for not less than one year. Each person applying for a permit for building purposes shall furnish a statement of the amount and kind of work to be done, or the Water Commissioner may estimate the same from plans furnished by the applicant. Whenever there is in a single building more than one business carried on subject to flat rates, the bill for the use of water for the entire building shall be rendered to the agent, owner or lessee. The schedule of rates, as above specified, shall become operative in each sub-district after this Ordinance becomes a law, as and when the permits for the use of water then in force expire.

## METER RATES SCHEDULE.

<i>General.</i>	<i>Use per six months.</i>	<i>Rates per 100 cu. ft.</i>
For the first	3,000 cu. ft. or less.....	\$0.15
For the next	3,000 cu. ft. or fraction thereof.....	.14
For the next	4,000 cu. ft. or fraction thereof.....	.13
For the next	5,000 cu. ft. or fraction thereof.....	.12
For the next	10,000 cu. ft. or fraction thereof.....	.11
For the next	15,000 cu. ft. or fraction thereof.....	.10
For the next	100,000 cu. ft. or fraction thereof.....	.09
For the next	260,000 cu. ft. or fraction thereof.....	.08
For the next	3,600,000 cu. ft. or fraction thereof.....	.07
For the next	4,000,000 cu. ft. or fraction thereof.....	.06½
For the next	10,000,000 cu. ft. or fraction thereof.....	.06
For all over	18,000,000 cu. ft.....	.05
<i>Manufacturing.</i>		
For the first	5,000 cu. ft.....	.06
For the next	10,000 cu. ft. or fraction thereof.....	.05
For all over	15,000 cu. ft.....	.04½
<i>Swimming Pool.</i>		
Per 100 cu. ft.....		.03
<i>Charity.</i>		
Per 100 cu. ft.....		.04½

## ASSISTANT WATER COMMISSIONER'S OFFICE

St. Louis, Mo., June 1st, 1918.

HON. EDWARD E. WALL,  
Water Commissioner.

DEAR SIR: The organization of the Assistant Water Commissioner's office, authorized by Ordinance 29630, approved April 17th, 1917, was effected May 16th, 1917. At that time the more important positions were filled by the transfer of employes of the Construction Branch and the Supply and Purifying Section and the office immediately assumed the responsibility for the miscellaneous clerical and record work formerly divided between the Operating Section and the Supply and Purifying Section. Office room was secured in the office of the Supply and Purifying Section at 34 East Grand Avenue and the necessary rearrangement of furniture and fixtures was effected with but little confusion.

An appropriation of \$22,200.00 was made to take care of salaries and wages for the fiscal year ending March 31st, 1918, but no appropriation was allowed for office expenses; these were charged chiefly against the Supply and Purifying Section. Appropriations have been provided for the current year so that it will be possible to keep all of the accounts separate and distinct.

The results shown after one year's operation seem to indicate that the centralization of office detail eliminates many duplications and tends towards a better co-operation between the Operating Section and the Supply and Purifying Section.

The management and operation of the central store room, located at Bissell's Point, is one of the important divisions of work coming under the supervision of the Assistant Water Commissioner's office. This store room, built in 1915, is a substantial reinforced concrete and brick building, one story in height, containing office and separate store rooms with ample floor area for stocking material in general use by the Operating and Supply and Purifying Sections. The individual rooms are equipped with both steel and wooden bins and shelving designed particularly for the purpose of making the stock readily accessible. The store room is in direct charge of a store-keeper with two regular

assistants, and such additional labor as may be required from time to time.

The original function which the store room was intended to perform covered a very wide scope, the idea being to carry a stock of material in quantities sufficient to supply the immediate needs of both the Operating and Supply and Purifying Sections upon demand. However, limited appropriations, high prices and uncertainty of deliveries have proved a handicap in this direction and it has been very difficult to operate along the lines for which it was originally designed.

Up to this time, therefore, the store room has been used chiefly as a clearing house for material purchased on requisitions; the material being received, checked up and redelivered immediately. Every effort is being made to increase the efficiency of the store room and it is hoped that it can be put in a position to render real service within a short time. Possibilities are unlimited and a substantial saving will undoubtedly be made as soon as it is possible to stock materials in quantities.

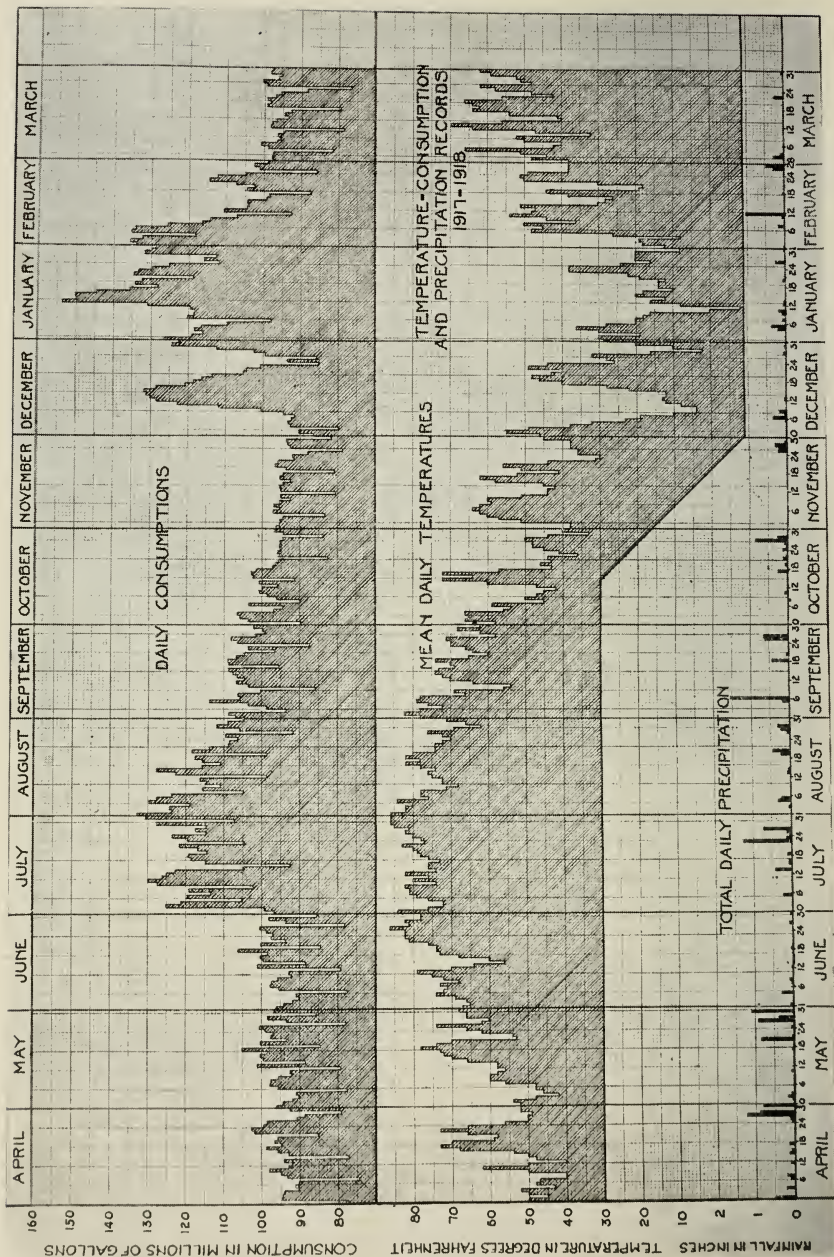
Several hundred photographic negatives, taken from time to time during some of the larger construction work and which have accumulated during the past few years, have been indexed and filed so as to be readily accessible at any time. In addition one print of each of the more important negatives has been made, mounted on linen and bound in a loose leaf binder so as to be convenient for reference.

The usual amount of photographic work has been done during the year, progress pictures have been made particularly of the various phases of the work in connection with the installation of the 110-million-gallon turbine at the Chain of Rocks. Some few lantern slides have been added to the collection, the Water Division now having 436 slides on hand.

New quarters have been set aside on the second floor of the old office building, 77 East May Street, and the photographic work now done in a crowded room at the City Hall will in a very short time be handled exclusively from this new location, which will provide ample facilities for the several classes of work that a photographer may be called upon to handle.

Progress on both contract work and work undertaken by the Division with its own force of men has been very disappointing. Difficulty in obtaining reasonably prompt delivery of materials and equipment coupled with the scarcity of competent labor have been the chief cause of slowing up construction work in both the Operating and Supply and Purifying Sections.

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Many improvements that under normal conditions would have been pushed to completion have been of necessity set aside for further consideration. Some very important improvements, chief among which may be mentioned, the covering of the storage basins at Baden and Bissell's Point have been deferred on account of failure to obtain the required appropriation.

The importance of covering the basins is emphasized each summer when, notwithstanding frequent cleaning, samples of tap water show the presence of small organisms and algae.

Work preliminary to the modernizing of the steam plant at Baden has been begun and contracts have been let for the major portion of the equipment. The advance in cost of manufacture has exceeded the allowance estimated at the time the appropriation was passed, and it may be necessary to obtain an additional appropriation in order to complete the work as originally planned.

The very severe winter of 1917-18, during a period of which the temperatures were unusually low, reaching a minimum of  $-17^{\circ}$ , taxed the resources of the department on several occasions.

During the period from January 12th to 15th the maximum pumping, filtration and consumption records were established, and had there not been a moderation in the weather it would have been difficult, if not impossible, to supply the demands made upon the works. The low service pumping at the Chain of Rocks was in excess of 163 million gallons on January 14th; 167 million gallons were filtered on January 15th, and on the 13th of January the high service pumps delivered 156,500,000 gallons to consumers and to Compton Hill Reservoir. The maximum daily consumption occurred on January 12th, when a new record of 153,500,000 gallons was reached. Had the new 110-million-gallon turbine at the Chain of Rocks been in service and the 6' 6" conduit from Baden to Bissell's Point been completed, the situation would have been more easily handled, but even after giving due weight to these improvements it is proper to assume that these periods of maximum consumption will occur with greater frequency each succeeding year, emphasizing the necessity for immediate consideration of the problem to either curb the extravagant use and waste of water or to build additional works as set forth in your Supplemental Report on the Water Supply of St. Louis of 1915.

Irregularity in the shipping and receipt of coal, due primarily to congestion in the freight yards, made it necessary to take coal from the reserve sheds at the three stations in order to supply the boiler plants.

Records indicate that this was the first time in many years that the Water Division was required to move any great quantity of coal from the reserve sheds. On account of the shortage of labor it became necessary to call upon the Distribution Section and upon the Sewer Division for assistance in moving the coal. Necessary labor with competent foremen were promptly furnished and the work of loading the coal was carried on in spite of the handicap caused by snow and cold weather.

The usual ice troubles were met with at the Chain of Rocks and required constant vigilance in order to keep the wet well from clogging with ice and interfering with the operation of the low service pumps.

The effect of the abnormally high prices paid for coal, lime and other commodities is very clearly reflected in the purification and pumping costs of the past year. For the year ending April 1st, 1917, the cost of purification per million gallons of water was \$5.58, while for the year ending April 1st, 1918, the cost was \$7.43. During the same periods pumping costs increased from \$8.54 to \$11.01 per million gallons. It can be reasonably expected that in spite of efficient operation and the use of labor-saving appliances a further increase will be noted at the end of the ensuing year.

The more important features together with a general review of the year's work are fully covered in detail in the reports of Mr. C. M. Daily, Engineer-in-Charge of the Supply and Purifying Section, and Mr. L. A. Day, Engineer-in-Charge of the Operating Section, which are handed you herewith.

Respectfully submitted,

FRANCIS T. CUTTS,

Assistant Water Commissioner.

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OLD CONDUIT, AFTER COLLAPSE.

## SUPPLY AND PURIFYING SECTION.

St. Louis, Mo., June 1st, 1918.

MR. FRANCIS T. CUTTS,  
Assistant Water Commissioner.

DEAR SIR: The work of the Supply and Purifying Section during the year ending April 1st, 1918, in addition to the purification of 39,373 million gallons of Mississippi River water, and its delivery in a pure state to the storage basins at Baden and Bissell's Point has included the completion of the reconstruction of Compton Hill Reservoirs; the continuance of the construction of the reinforced concrete conduit from Baden to Bissell's Point which was begun in the fall of 1916, and which will hardly be completed in the present year; the building of 185 feet of reinforced concrete conduit to replace that section of the nine-foot brick conduit north of Prairie Avenue, which collapsed May 14th, 1917; the construction of a 9 foot by 230 foot chimney for the High Service Station No. 2 at Bissell's Point; the commencement of a new 9½ foot by 235 foot chimney for High Service Station No. 3 at Baden, and the practical completion of the dike work for protection of the water supply at the Chain of Rocks.

The operation of the Water Works Railway together with the maintenance of the roads, parks, buildings and other structures has received careful attention throughout the year.

The following expenditures make up the total cost of the work of the section for the year:

Salaries of employes, excepting guards.....	\$222,899.62
Salaries of special guards.....	37,121.57
Chemicals and all other supplies.....	236,963.81
New construction.....	9,398.01
	<u>\$506,383.01</u>

Contract work amounting to \$271,563.83 was divided among fourteen contracts, ranging from \$94.67 to \$113,668.63; ten of these contracts were let during the year.

The number of employes of this section have ranged from 248 in May to 315 in October, the average wage being \$79.81 per month. An

increase of wages for laborers on general work from 25c to 30c per hour was made shortly after the first of the year, which was later raised to 35c. Twenty-two men have been injured on the work, losing 367 days for which they were allowed wages totaling \$844.87. This amounts to  $3\frac{1}{4}$  per cent of the total pay roll and is \$1,452.83 less than the amount paid last year for the same item.

A large number of employes of the Section have resigned during the past year to join some branch of the National Army. Among some of the older employes who have resigned are: Gurdon G. Black, Engineer-in-Charge; John C. Pritchard, Assistant Engineer; Richard Utter, Inspector; Wm. R. Mayfield, Draftsman; Chas. Miller, Electrician Helper; Herman F. Sieckman, Inspector. Others who have resigned or were transferred to another department are: S. W. Jacobs, Watch Superintendent of the Filter Plant, and L. Morisseau, Foreman of the Coagulant House. Men from the lower ranks were promoted to fill the vacancies of those who left the Section, where it was possible to do so.

Shortly after war was declared by Congress, an appropriation of \$50,000.00 was secured for protecting the waterworks property. A seven-foot barbed wire fence was built around the plants at the Chain of Rocks, Baden and Bissell's Point; gates were provided and watchmen placed at the gates. All employes were provided with identification buttons and no strangers were allowed inside the wire fence. A company of the State militia guarded the three plants from April 15th to July 31st, when they were called away to perform other duties. Since August 1st, sixty private watchmen in three shifts have patrolled the grounds and conduit from Bissell's Point to the Chain of Rocks.

Some of the important features of the year's work will be described in detail.

### REMOVAL OF SAND FROM THE NEW TUNNEL.

In the fall of 1916 the new tunnel was found to be about one-half full of sand carried in from the sand-bars formed alongside of the new intake tower. An unsuccessful attempt was made in June to remove this sand while the tunnel was in use by a water jet pump placed in the uptake shaft. During October and November, 1917, the tunnel was unwatered, sand shoveled into wheelbarrows, wheeled to the uptake shaft, hoisted 95 feet to the top and dumped on the ground. When the tunnel had been cleaned for a distance of 600 feet on each side of the shaft by this method, the water was turned in at the tower to wash the sand towards the shaft, when the tunnel was again unwatered and the

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OLD CONDUIT, SHOWING TEMPORARY REPAIRS.

sand removed as before. This operation was repeated three times and after the third cleaning less than 10 inches of sand was left in the tunnel, amounting to little more than 5 per cent of its area. The sand remaining in the tunnel will probably be slowly removed by the water and no further trouble is expected from this source so long as the formation of sand-bars is prevented by the dikes.

An expenditure of \$6,261.01 was incurred in removing about 1,500 cubic yards of sand, of which approximately 1,200 yards is fit for use and will be used by the department. The value of this sand at the present time is \$1,340.00, leaving a net cost of \$3.28 per yard for removing the sand from the tunnel.

### BREAKING OF THE OLD 9-FOOT BRICK CONDUIT.

The building of the new 6' 6" reinforced concrete conduit on the west side and against the old 9-foot brick conduit continued from the early fall of 1916 until May 14, 1917, without encountering any difficulties, when on that evening the old conduit collapsed for a length of 185 feet, the entire distance that the excavation for the new conduit was ahead of the finished work. The break occurred about 7:30 p. m., after all the workmen had left, no signs of any weakening of the old conduit having been noticed. The gates on the conduit at Baden and Bissell's Point were immediately closed, allowing Baden Pumping Station to be supplied with water from the Chain of Rocks, while Bissell's Point Pumping Station could have only the two storage basins at Bissell's Point to draw upon until the conduit was repaired and in service. This supply lasted until 8:00 a. m. next morning.

Men, materials and equipment were immediately rushed to the scene and at 3:00 a. m. on the 15th an electric crane operating a clam shell bucket was in operation removing the debris and the contractor's equipment which had fallen into the conduit. Sacks filled with clay were used to form an embankment on both sides of the old conduit, and at 8:00 p. m. on the 15th water was again flowing through the temporary channel into the storage reservoirs at Bissell's Point.

The shutting down of the pumping station at Bissell's Point for twelve hours caused but little inconvenience to the public as the Baden Pumping Station was operated to its maximum capacity, and with the storage reservoirs at Compton Hill in service, nearly all demands for water were supplied during this time.

Plans for repairing the old conduit and constructing the new one around the break were prepared. The plans involved the driving of

steel sheet piling for a distance of 195 feet along the west side of the collapsed conduit and moving the center line of the new conduit on an off-set 13.78 feet west of its original location; the connecting of the old and new conduits north of the break and the building of stop plank chambers in both conduits. The work of driving the sheet piling and building the new conduit around the break was done by the contractor on force account.

The danger of the old conduit again collapsing, should the new one continue to be built against it, seemed grave owing to the poor quality of the concrete outside the brick work; in many places it could be picked out by hand, showing a very poor mixture. In other places the concrete was in very good condition, but cracks due to settlement in the old conduit indicated that it would be unsafe to continue the work as planned, and it was decided to build the conduit on the continuation of the line of the off-set as built around the break.

This change in the plans involved additional cost of labor and form work, and the approval of the Board of Public Service was secured to accept a proposition made by the Hogan Contracting Company to build the remainder of the conduit in the new location for the same unit prices, excepting the concrete below the spring line of the arch, for which an additional charge of \$2.00 per yard would be added, and that the excavation should be measured 1 foot outside the west line (to allow for form work), and on a slope of one horizontal to one vertical from the bottom of the excavation on the east side. The increase in the unit cost of concrete and volume of excavation made an estimated increase in the contract of \$25,000.00.

The cost of building 502 feet of the new conduit around the break and one stop plank chamber, including the cost of repairs to the plant and driving 2,925 lineal feet of steel sheet piling, was \$16,165.14 or \$32.20 per foot of conduit.

The cost of the temporary repairs to the old conduit was \$712.23 and of the permanent repairs \$7,384.01.

The old conduit was rebuilt to its old dimensions by the employees of the department in August, September and October, after the connection had been made between the new and old conduit above the break, and the water diverted through the new conduit south of the connection. See Plate No. . . . . The old conduit was put in service October 18th, both conduits being used south of the connection since that date.

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OLD CONDUIT—FORM WORK FOR PERMANENT REPAIRS.

### 6' 6" CONDUIT.

Owing to the scarcity of labor, the difficulty experienced in getting materials delivered by the railroads, and the delay incidental to the break in the old conduit, the contractor was unable to make the progress he would have made under normal conditions. During the year 9,500 lineal feet of conduit was built at a cost of \$126,320.06, leaving 5,744 feet of conduit and the gate chamber at Baden to be built.

The specifications provide that the new conduit should be practically water tight, and to be tested in sections of about 1,500 feet long. In no section tested should the leakage exceed an average of three gallons per foot per twenty-four hours.

Up to date only one section has been tested. The test was made on July 6th and again on August 16th and was conducted as follows:

Water-tight bulk-heads were built in the conduit near the Terminal Chamber at Bissell's Point and in a stop plank chamber above the break, and the section between the bulk-heads filled with water from a fire plug. After allowing the water to remain in the conduit about one week the conduit was again filled, the water rising about  $3\frac{1}{2}$  feet in two manholes, and the time required for the water to recede from the manhole was noted. From the known volume of the manholes the loss in leakage per foot per day was determined.

The results in both cases showed the leakage was far more than specified and also showed that the leakage was reduced about  $\frac{1}{3}$  when the head on top of the conduit approached zero. When the head was about  $\frac{1}{2}$  foot above the top of the arch the leakage amounted to about 11.5 gallons per foot per day in the last test, while on the first day the leakage was about 20.6 gallons.

Further tests will be made and it is expected that the leakage will be reduced below the amount specified.

### ICE TROUBLES.

The unusual cold winter beginning December 8th and continuing until March 1st necessitated keeping a force of men at the towers and in the wet well the greater part of the time to prevent the ice from shutting off the supply of water. Six men were kept at No. 1 tower and two men at No. 2 tower. In the wet well the number of men varied from none to twenty. At times the two bucket ice hoisting machines in the wet well were unable to remove the ice as fast as it came in, and

on February 21st and 22nd ice collected to a depth of 16 feet all over the well, this serious condition lasting for a period of twelve hours. Ice troubles always follow a sudden fall in temperature, approaching zero or lower, in the upper river valleys, when the river is not frozen over at the towers. There are five conditions favorable to the production of Frazil ice which is the chief cause of our ice troubles, namely, low temperature, clear water, open river, strong wind and snow or sleet; these conditions produce super-cooling of the water to a fraction of a degree; the water entering the tunnel is under increased pressure of nearly two atmospheres which prevents any formation of ice and the consequent rise in temperature which would otherwise occur, due to the increased agitations; but on reaching the wet well the agitation continues and the pressure is reduced, causing the Frazil ice to form and the temperature to rise to the freezing point. A certain amount of small floating ice is also brought in with the water, but it is never very troublesome.

The cost of removing ice from the wet well last winter was \$1,418.07, exclusive of the cost of power, water used in washing the ice into the river and the engineman's wages.

At the present time it is necessary to increase the capacity for removing the ice, and plans have been made to introduce steam into the new tunnel in the uptake shaft on the river bank a distance of 560 feet from the wet well in such quantities as may be necessary to raise the temperature of the water in the tunnel a small fraction of a degree, enough to prevent the formation of ice. This plant will be in the nature of an experiment. The steam will be run direct from the boilers through a 4-inch pipe to the uptake shaft and delivered into the tunnel where it will have a distance of 560 feet to travel and mix with the supercooled water before reaching the wet well.

### COAL SHORTAGE.

During the severe cold weather last winter the delivery of coal was so irregular that a special force of men had to be employed at each station to keep the boilers supplied with coal from the storage shed. At the Chain of Rocks small flat cars were used, a team of horses pulling them from the shed to the hoppers at the boiler room. At Baden the coal was shoveled in coal cars and hauled by steam locomotives to the boiler room and shoveled into bins. At Bissell's Point two small dump cars were made, the coal was shoveled into them,

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hauled by electric cars and dumped into hoppers. The following quantities of coal were taken from the storage shed:

Chain of Rocks storage shed.....	650 tons
Baden storage shed.....	580 tons
Bissell's Point shed.....	2,080 tons

### HURDLE DIKES.

The work on the hurdle dikes and bank protection on the east side of the river above the intake towers was started in June during high water when the floating plant could be used to weave the willow mattress and drive piling in the dike across the slough above the four channel dikes. This dike was completed June 21st and nothing further was done on the dikes until low water on August 1st, when work was begun on No. 1 and No. 3 dikes. Later work on No. 2 dike was started and continued until December 8, 1917, when cold weather and floating ice prevented further work being done until spring. At this time the shore ends of the three dikes were not built and only about one-half of No. 3 dike was clumped.

The river froze solid on January 14th, and on January 24th and 25th the contractor and employes of the Water Division dynamited the ice from a point below No. 3 dike to the Illinois shore above No. 1 dike on a line about 100 feet outside the ends of the dikes, expecting the ice to shear along this line when it broke in the spring and thereby protect the ends of the three dikes.

When the ice moved on February 12th it did not shear off on this line, but sheared on a line further out in the channel and no damage was done to the dikes.

Work was resumed on the dikes on March 13th, and at the present time the dike across the slough and the three upper hurdle dikes are finished, together with the bank protection at the ends of the dikes. No. 5 dike has all the mattress sunk and about one-half of the piling driven; the bank is graded and paved. The amount of work done on the dikes to April 1st was \$74,786.44.

It is expected that this work will be completed by the first of June, providing the water remains low until that time.

### COMPTON HILL RESERVOIR.

The work of reconstructing Compton Hill Reservoir has been continued throughout the year; two new contracts were let during the year and the contract with the Hiram Lloyd Contracting Company was completed November 1st, the total payments on the contract amounting to \$301,792.46. Before putting the north basin in service, it was about

one-half filled with water from the new 36-inch steel main in which hypochlorite of lime had been added for sterilizing the mains and this chemically treated water allowed to stand in the basin for a few days. On emptying the basin a couple of paving blocks on the east side of the bottom near the foot of the slope were found to have raised up about one foot; after the waterproofing membrane below them broke and allowed the water which had collected underneath the membrane to escape, the blocks fell to their original position, new pitch was run in the joints and the basin put in service August 8th.

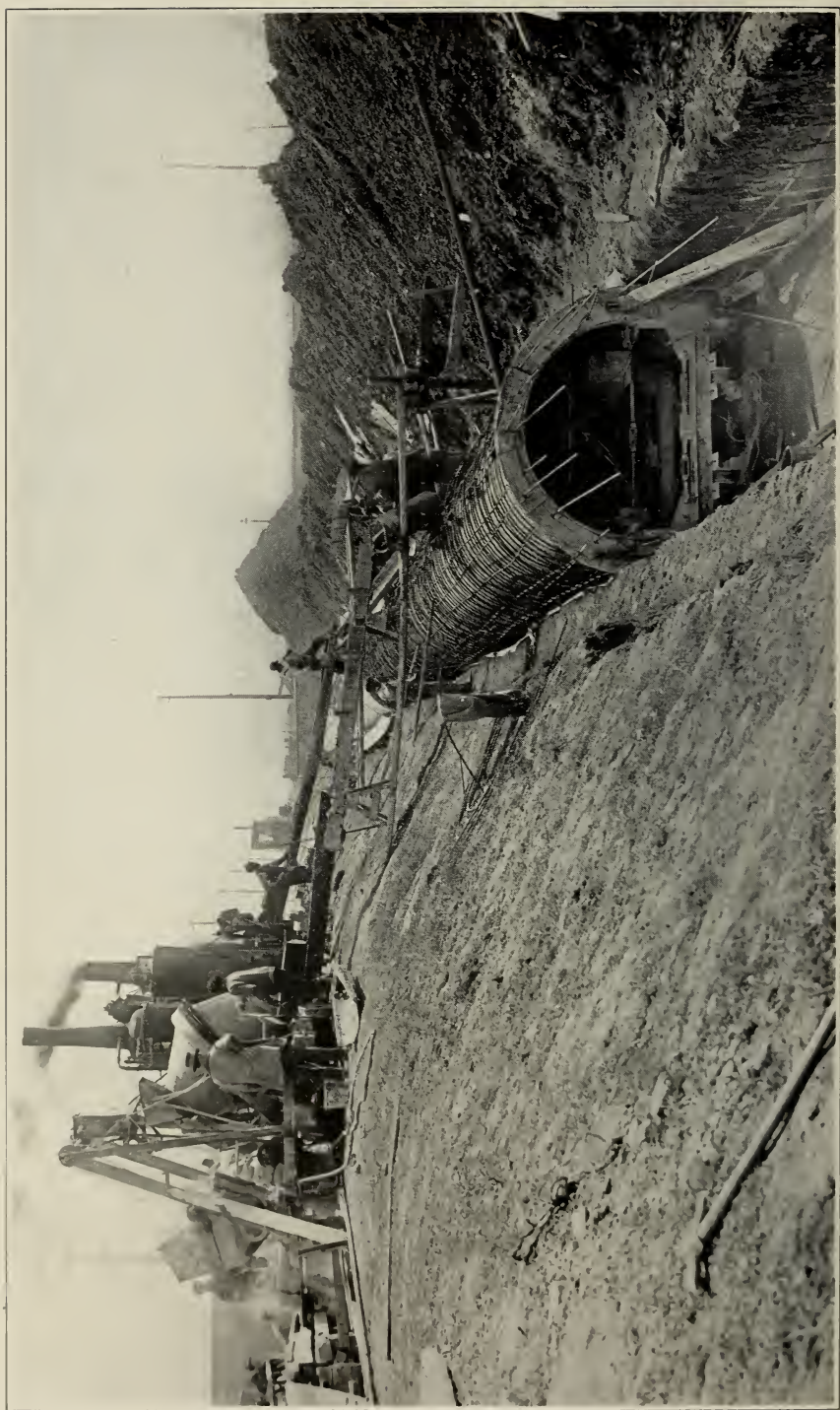
The vertical walls of this reservoir were waterproofed by painting the interior surface with three coats of hot asphalt. This work was done by the Trinidad Asphalt Company at the contract price of \$0.0374 per square foot. This coating proved effective, but was worn away during the winter by the vertical motion of the ice as it moved up and down with the varying elevation of the water surface. Apparently enough of the coating material found its way into the minute openings and hair cracks in the concrete to prevent leakage, as the walls are perfectly water-tight at this time.

During the summer numerous complaints of the presence of foreign matter and minute organisms in the tap water were received from the territory supplied from this reservoir. The presence of these organisms is primarily due to the contamination of the water in the open basins at Bissell's Point prior to its being pumped into Compton Hill Reservoir. The water then being exposed in this reservoir to the sun and air affords an excellent opportunity for the multiplication of these organisms and for the growth of algae. So long as the Bissell's Point basins remain uncovered, the presence and growth of the objectionable organisms and algae will continue in Compton Hill Reservoir, at least during the summer months. Fortunately they are harmless, although offensive to the taste.

The contract for building five flights of stairs at Compton Hill, one at each of the four corners of the basin and one in front on the west side, was awarded to Cudmore Construction Co., October 23d, 1917, for the various items at the following prices:

Earth excavation.....	\$ 2.00 per yard
All concrete in footings, stairs and piers...	12.75 per yard
For all finishing risers and treads, the sum of	.12 per square foot
	of tread
For all synthetic stone, balusters, piers and cap columns, the sum of.....	5,070.00
For all bush hammering, the sum of.....	.10 per square foot
For all reinforcing steel in place, the sum of	.065 per lb.

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Work was begun November 13th, 1917, and on April 1st it was about 90 per cent complete. The work will probably be finished during the present month.

The stairs with ornamental balusters add greatly to the appearance of Compton Hill Reservoir, and to complete the work of reconstruction of Compton Hill Park it will be necessary to construct a gravel walk around the basins on top of the embankment. Plans and specifications have been prepared for this work at an estimated cost of \$1,300.00. The plan calls for asphaltic cement-filled macadam walks, 8 feet wide, containing 1,980 square yards of surface.

It will also be necessary to reduce the 20-foot roadways in the grounds about the reservoir to gravel walks, 8 to 12 feet wide, for which plans have already been made. The probable cost of this work is \$20,000.00. However, the uncertain depth of macadam in these roadways may cause the cost of the work to vary materially from our estimated cost.

#### DELIVERY WELL AT CHAIN OF ROCKS.

During last winter the employes of the department constructed five buttress walls to reinforce the east side of the delivery well at the Chain of Rocks, preparatory to connecting the 110-million-gallon pump to the delivery well with the 72-inch cast-iron main. Fifteen concrete piles were driven and fifty-seven yards of concrete placed. The cost of this work, including labor and material, was \$2,011.91.

#### COVERS FOR BADEN AND BISSELL'S POINT RESERVOIRS.

Plans and specifications were drawn for covering the basin at Baden and two basins at Bissell's Point. The covers were designed two-way slab-and-beam construction supported by reinforced concrete columns, the thickness of the slabs being 4 inches. The top of the slab was to be covered with two coats of asphalt and gravel.

The previous designs for these basins have been for flat-slab construction design to support 2 feet of earth cover. This necessitated a much heavier construction which made the flat slab the cheaper, but without the 2-foot earth cover, the two-way slab-and-beam construction gave the cheaper design. The estimated cost of the Baden cover was \$94,900.00 based on current prices July 1st, 1917. The covers for Bissell's Point basins were of the same design as those at Baden and the estimated cost was \$164,500.00.

This necessary work remains undone as no appropriation was made for it. The necessity for covering the basins, especially those at Baden and Bissell's Point, is beyond question if pure water is to be supplied to the consumers at all times during warm weather.

The cost for covering the basins this year will exceed the estimated cost of last year by about 20 per cent.

Examination of the covered basin at the Head House, namely, 7 $\frac{3}{4}$ , was made a short time ago, and it was found to be entirely free from algae growth, snails, bugs or other evidences of unwholesome condition of the water, as was also the influent flume and drawing conduit between the basins. This basin when covered in July, 1916, had its sides and bottom covered with algae growth, and cleaning was necessary about once a month during hot weather to keep the basins in good condition, but with the cover in place the algae growths that were on the sides and bottom have disappeared, which is proof, if any is required, that the covering of the basins will prevent the numerous forms of algae growth, snails, bacteria and bugs of various kinds that flourish in water exposed to sunlight and air.

### MIXING CONDUIT.

Examination made of the mixing conduit west of the basins at the Chain of Rocks, a short time ago, showed the two east conduits to be nearly freely from mud, but deposit, chiefly of calcium carbonate, varying in depth from  $\frac{1}{2}$  inch to two inches was on the walls. This scale was soft and easily removed when the water was drawn out. In the two west conduits the deposit in the bottom varied from 6 inches to 18 inches, which perhaps is one-third of the amount of sediment in these conduits when last examined in July, 1916.

The west conduit at that time was so full of mud that it was impossible for a man to go through it. The scale on the side walls of these conduits varied in thickness from 1 inch to 3 inches and was soft and easily removed.

### CHIMNEY AT BISSELL'S POINT.

The 230 foot brick and concrete chimney at Bissell's Point was completed December 27th, 1917, at a cost of \$21,697.08. Before putting this chimney in service some of the heated gas from one boiler was allowed to enter the chimney for forty-eight hours, and when put in service the temperature of the gas was raised to 550° Fahrenheit. After twelve hours in use vertical cracks in the brick work on each side of the base appeared, due to expansion in the concrete. These cracks were





230-FOOT CHIMNEY, BISSELL'S POINT.

about  $\frac{1}{16}$ -inch wide and at the present time are not noticeable a short distance from the stack.

### 235-FOOT CHIMNEY AT BADEN.

Plans and specifications were prepared for a 235-foot brick chimney similar in design to the one at Bissell's Point, and the contract awarded on February 14th, 1918, to John V. Boland Construction Company, in the sum of \$31,427.00. Five bids were received for this work, as follows:

Frein Masonry and Stone Company.....	\$45,000.00
Wiederholdt Construction Company.....	41,985.00
William McDonald.....	33,492.00
J. H. Hadelor.....	31,867.00
John V. Boland Construction Company.....	31,427.00

The contract provides for four 7-foot square piers extending from the base of the stack to bed rock. Borings were made at the side of each pier and shale was encountered at an elevation of about 91 feet. The records of the excavation made for the wet well and storage basin indicated a possible thickness of 10 feet of shale at this point, but on excavating for the two north piers, 17 feet of shale had been penetrated without finding limestone. The contract provides that the work of excavation below elevation 82 will be done by force account, 15 per cent extra being allowed for profit and overhead charges. Material for the contract and nearly all the steel is on the ground and two piers are excavated to an elevation of about 74 at the present time. The contract provides that the work shall be completed on or before September 1st, 1918.

### WATERWORKS RAILWAY.

During the past year a cinder fill has been made along the right-of-way, the principal work being the maintenance of the track and drainage. At the Sanitarium the Betts guard rail has been placed in the curve from the Iron Mountain tracks at a cost of \$933.00 for material and \$1,628.39 for labor. At the Municipal Dock the material and labor furnished for laying a spur track for filling amounted to \$454.67, all of it being paid from the general revenue.

### STEAM DIVISION.

All the switching of coal, chemicals and contractor's supplies have been handled by a single crew of four men during the year. Locomotive No. 2 and Locomotive No. 1,000, borrowed from the Municipal Free

Bridge, were used until February 20th, when No. 1 which had been in the Terminal shop for general overhauling was returned to the department. Since that time the work of switching has been done by Locomotives Nos. 1 and 2. The cost of repairing Locomotive No. 1 was \$2,953.10.

On June 5th a new steel side-dump car of 50 tons capacity was purchased for the sum of \$2,250.00 to be used in handling cinders. During the year the steam locomotive handled 119,703 tons of material in 2,873 cars at a cost per car of \$7.1337 or \$0.0370 per ton mile switching. Two thousand three hundred and sixty cars were handled for the department, 413 for contractors on city work, 30 for city departments and 70 for outside parties. Switching cars for parties other than contractors on waterworks contracts has been done for a nominal charge of \$1.00 per car, a sufficient deposit being made to cover all probable demurrage. The table on page 47 gives complete figures for the year, both as to cost and work done.

### ELECTRIC DIVISION.

In addition to the passenger traffic between Bissell's Point, Baden and the Chain of Rocks the electric division has handled all package freight between these points, has switched the cars of material for the contractors on the new conduit between Baden and Bissell's Point and at the break in the conduit for the department as well as cinder cars. One crew has been employed almost continuously for this work. During the year 138,248 employes were carried, 16,329 full fare passengers, 22,408 half-fare and 29,966 cash fare, making a total of 353,851 passengers carried during the year.

Between Baden and the Chain of Rocks 8,299 passenger car trips were made, and between Baden and Bissell's Point 3,894 trips, making a total of 12,193 passenger car trips with a total mileage of 49,030. These trips do not include the switching of cars or extra trips made for special purposes on which no passengers were carried. The unit cost, which is misleading in a way, has been made up as in former years, based on the total cost divided by the number of passenger trips or mileage as the case may be. The operating and maintenance expense as in former years is based on the total cost. The cost of power used last year was \$12,262.70 against \$4,966.39 the year before, a difference of \$7,296.31, due chiefly to two causes, one being the increased cost of fuel and labor and the other, the different method used in estimating the cost of power by the Operating Section. As no division was made, or is possible to be made, between the passenger cars and the cars





CORNER STAIRS—COMPTON HILL RESERVOIR.

used for switching or hauling freight, both the unit cost per passenger and the cost per car mile are entirely misleading.

The total amount received from fares during the year aggregate \$7,323.55, while the total cost for operation and maintenance has been \$30,857.60 or \$0.0872 per passenger carried. The table on page 48 gives the detailed cost and data for operation for the year.

### PARKS.

The reconstruction of the comfort station at the Chain of Rocks was completed in May. The work was done by the employes of the City, with the exception of the plumbing work, which was done by contract awarded to the Hart Plumbing Company for the sum of \$477.00.

### REPAIRS TO BUILDINGS.

The tar and gravel covering on the concrete roof of the Coagulant House was replaced in October by the St. Louis Roofing Co. for the sum of \$94.67.

On the evening of Sunday, January 13th, a steam radiator broke in the Chemical Laboratory and steam escaped until discovered on the following Monday morning. The heat and moisture ruined practically all of the office furniture and the doors and soaked the plaster in three rooms so that it had to be replaced. Work of repairing this building was done by the department and new furniture purchased, the total cost of repair and purchase of new furniture amounting to \$1,754.34.

During the afternoon of March 9th a windstorm tore off the roof of Engine House No. 2 at Bissell's Point and the monitor of Engine House at Baden. Contract was awarded to the St. Louis Roofing Co. for repairing the roof at Bissell's Point for the sum of \$234.00. The roof at Baden was repaired by employes of the Division.

During the morning of March 11th fire broke out in No. 4 Gatehouse on the west side of the Chain of Rocks basins, due to defective flue. The Gatehouse at the time was used by one of the guards. The fire damaged the roof and windows. Repairs have been made by Division labor.

The reconstruction of High Service Station No. 2 at Bissell's Point, which has been in progress several years, contemplated replastering a portion of the walls, painting the entire interior, refinishing the steps at the west entrance and building an observation balcony of reinforced concrete overlooking the entire engine room from the west doors, all of which work was completed during the year with labor employed by the Division.

### HOMER'S DIKE.

The elevation of Homer's Dike has been reduced from year to year until at the present time the elevation west of the old tower varies from 73 to 81 feet. In consequence of this reduction in elevation a large volume of the water now passes west of the tower No. 1, forming a sand bar on its south and southwest side, entirely covering the new emergency gate and at times part of the old emergency gate. During a severe winter the river west of the tower, above Homer's Dike, usually freezes over and the water underneath the ice flows straight over the dike instead of passing eastwardly along the dike on the south side of the tower as it formerly did. As a result of this condition, very little water can be drawn from the west side of the river, which would be very desirable in severe weather, as then it is protected by a sheet of ice and contains but very little Frazil ice. Now the water from the channel which contains the Frazil ice is drawn into the intake and tunnel, causing ice troubles in the wet well.

Plans have been prepared for raising Homer's Dike to elevation 83 feet from the shore to old tower, a distance of 1,550 feet, at an estimated cost of \$20,000.00.

This work can be done during the fall when the river is below a stage of 82 feet. The materials required are willows, cable and stone, which could be transported by barges.

### TEMPERATURE VARIATIONS OF CONCRETE WALLS.

During the past year a series of temperature determinations in a concrete wall at Compton Hill Reservoir was made. The object of these tests was to determine the difference in temperature between various parts of the wall during sudden changes and extreme variations in temperature. The range in temperature of the air varied from  $-17^{\circ}$  to  $106^{\circ}$ , and the range in temperature of the concrete varied from  $-16^{\circ}$  to  $105^{\circ}$ . It will be seen from the tables given that immediately after pouring the concrete the temperature of the air dropped from  $58^{\circ}$  to  $31^{\circ}$  and the concrete rose in the same period from  $58\frac{1}{2}^{\circ}$  to  $68\frac{1}{4}^{\circ}$ . After the initial setting period the temperature of the concrete followed closely the temperature of the air. The west side of the wall shows a higher temperature than the air in the afternoon, due to the direct rays of the sun.

In a report on page 49 to page 52, inclusive, Mr. Wiederholdt, who made the determinations, gives a description of the methods of determining the temperature and table of the results obtained.

### ACKNOWLEDGMENTS.

The work accomplished in this section during the year has been due to the interest taken in the work and the spirit of co-operation of all the employes of the section. Many have put in overtime and have given up vacations to further the progress of the work.

The following tables and reports are appended:

Table 6. Passengers carried on Electric Division, Waterworks Railway.

Table 7. Operation of Steam Division, Waterworks Railway.

Table 8. Operation of Electric Division, Waterworks Railway.

Report of Mr. August V. Graf, Chemist-in-Charge of the Purification Plant.

Report of August G. Nolte, Superintendent Filter Plant.

Report of F. R. Wiederholdt on variations and temperature of concrete.

Respectfully,

CORNELIUS M. DAILY,

Engineer-in-Charge, Supply and Purifying Section.

TABLE No. 6.  
PASSENGERS CARRIED ON ELECTRIC DIVISION WATER WORKS RAILWAY, 1917-1918.

Collections from Cars					Tickets Sold		Cash Remitted to Water Commissioner				
Employees	Full Fares	Half Fares	Number of Cash Fares	Total Pay Passengers	Grand Total Passengers	Half Fares	Full Fares	Cash Fares	Half Fares	Full Fares	Total Cash
April, 1917.....	12,246	1,577	1,175	13,283	25,559	880	11,376	\$ 58.75	\$13.75	\$355.50	\$ 428.00
May.....	11,621	1,927	1,431	13,856	25,477	2,656	12,640	71.55	41.50	395.00	508.05
June.....	11,411	1,815	2,823	20,956	32,367	3,296	19,632	141.15	51.50	613.50	806.15
July.....	11,291	1,789	10,060	43,829	55,120	2,112	38,344	503.00	33.00	1,198.25	1,734.25
August.....	11,623	1,448	3,788	24,567	36,030	1,888	19,952	189.40	29.50	623.50	842.40
September.....	11,324	1,253	3,110	22,320	33,644	1,568	18,168	155.50	24.50	567.75	747.75
October.....	12,231	2,419	1,944	17,266	29,497	3,056	12,168	97.20	47.75	380.25	525.20
November.....	12,790	2,225	1,408	14,055	26,845	1,040	9,944	70.40	16.25	310.75	397.40
December.....	10,757	8,738	1,438	21,973	22,968	5,344	9,536	51.00	83.50	298.00	432.50
January, 1918.....	11,555	8,137	1,625	10,613	22,168	848	7,920	42.55	13.25	247.50	303.30
February.....	10,175	7,819	1,727	10,534	20,709	976	7,664	49.40	15.25	239.50	304.15
March.....	11,174	9,459	1,368	13,108	24,282	2,800	11,304	68.40	43.75	353.25	465.40
Total.....	138,198	163,229	29,966	215,603	253,641	26,464	178,648	\$1,498.30	\$413.50	\$5,582.75	\$7,494.55
Minimum Week Day, January 12th, 1918.....	471	170	11	207	678	.....	104	\$ 0.55	.....	\$ 3.25	\$ 3.80
Maximum Week Day, July 4th, 1917.....	94	2,163	288	2,539	2,633	80	4,704	14.40	\$1.25	147.00	162.65
Minimum Sunday, January 13th, 1918.....	511	138	11	177	688	16	288	.55	.25	9.00	9.80
Maximum Sunday, July 22d, 1917.....	509	2,192	867	3,179	3,688	256	3,840	43.35	4.00	120.00	167.35

TICKETS SOLD TO BOARD OF EDUCATION.

Half Fare Tickets			Full Fare Tickets			Cash for Half Fares		Cash for Full Fares	
Half Fare Tickets	Full Fare Tickets	Full Fare Tickets	Full Fare Tickets	Full Fare Tickets	Full Fare Tickets	Cash for Half Fares	Cash for Full Fares	Cash for Half Fares	Cash for Full Fares
1,536	704	704	704	704	704	\$24.00	\$22.00	\$24.00	\$22.00
1,600	192	192	192	192	192	25.00	6.00	25.00	6.00
1,536	704	704	704	704	704	24.00	22.00	24.00	22.00
4,352	832	832	832	832	832	68.00	26.00	68.00	26.00
1,408	800	800	800	800	800	22.00	25.00	22.00	25.00
Total.....	10,432	3,232	3,232	3,232	3,232	\$163.00	\$101.00	\$163.00	\$101.00

REMARKS.—July was the largest month for handling pay passengers and cash receipts. November was the largest month for handling employees.

TABLE No. 7.  
ST. LOUIS WATER DIVISION.  
Supply and Purifying Section.  
Report of Steam Railway for Year of 1917-1918.

WORK DONE				Operating and Maintenance Expenses	UNIT COST
Material Moved	No. of Cars	Tons of Material	Ton Miles		
Coal.....	1,639	70,758	296,052	Crew.....	\$ 6,584.43
Lime.....	492	16,856	133,114	Repairs Locomotive No. 1	2,986.25
Iron.....	68	2,232	18,187	Repairs Locomotive No. 2	669.92
Gravel.....	235	11,979	31,752	Locomotive maintenance.	177.91
Sand.....	131	6,248	15,240	Coal.....	3,835.96
Cement.....	71	3,006	14,238	Track maintenance.....	4,736.65
Alumina.....	49	1,853	15,503	Oil, waste, etc.....	111.70
Steel.....	11	219	380	All other supplies.....	57.18
Cinders.....	65	2,779	15,497	Car inspection.....	307.72
Macadam.....	10	473	237	Car repairs.....	934.44
Brick.....	2	67	34	Loco. No. 1,000.....	93.00
Miscellaneous.	100	3,283	13,562		
Total....	2,873	119,703	553,796	Total.....	\$20,495.16

Cost of switching per ton mile.....\$0.0370  
Cost of switching per car.....7.1337

Total cost of switching coal.....\$10,953.92  
Total cost of switching lime.....4,925.22  
Total cost of switching iron.....672.92  
Total cost of switching alumina...573.61

Water Division.....2,360 cars.  
Contractors, City work.....413 cars.  
City departments.....30 cars.  
Outside parties.....70 cars.

#### REMARKS.

Locomotive No. 2 was laid up for repairs during the month of March.  
One five-ton dump car for use in handling cinders was purchased at a cost of \$2,250.00.  
Repairs amounting to \$2,953.10 on Locomotive No. 1 were required, Terminal Railroad Association performing the work.  
Cinder track constructed at Chain at a cost of .....\$186.76  
Cinder track constructed at Baden at a cost of .....562.81  
Machine shop track constructed at Baden at a cost of .....212.24

TABLE No. 8.  
ST. LOUIS WATER DIVISION.  
Supply and Purifying Section.  
Report of Electric Railway for Year of 1917-1918.

PASSENGERS CARRIED			Operating and Maintenance Expenses	
Passes { Fares.. {	Monthly and annual.....	} 138,248 163,229 22,408 29,966	Labor.....	\$10,452.24
	Labor.....		Repairs to line.....	1,262.92
	Full fare tickets.....		Power.....	12,262.70
	Half fare tickets.....		Track maintenance.....	2,051.12
	Cash.....		Oil, waste, etc.....	5.34
Total.....		353,851	All other supplies.....	62.81
TRIPS AND MILEAGE			Repairs Car No. 2.....	1,058.52
			" " " 3.....	616.29
			" " " 7.....	696.39
			" " " 10.....	685.25
			" " " 11.....	565.17
			Repairs to railway stations.....	744.56
			" " tower car.....	196.04
			" " lights.....	8.35
			Station—Prospect Hill.....	189.90
UNIT COST			Total.....	
Cost per passenger.....		\$0.0872	\$30,857.60	
Cost per trip.....		2.53		
Cost per car mile.....		.6293		
CASH HANDLED				
Ticket sale. {	Full fares.....	\$5,528.75 296.50 1,498.30		
	Half fares.....			
Cash fares.....				
Total.....		\$7,323.55		

## REMARKS.

Car No. 2 was repainted during May and was also laid up for repairs during the last half of April and for about three weeks during September.

Car No. 3 was used principally for line work during the year. Was also repainted in June.

Car No. 7 was repainted during April.

Car No. 10 was laid up for repairs during January and February.

Car No. 11 was laid up for repairs during November, December and January.

Cars Nos. 10 and 11 were used in switching material for Hogan Construction Co. during the past year.

## SUPPLY AND PURIFYING SECTION.

### REPORT OF TEMPERATURE VARIATIONS IN A CONCRETE WALL.

St. Louis, Mo., June 1st, 1918.

MR. C. M. DAILY,  
Engineer-in-Charge.

DEAR SIR: In the reconstruction of Compton Hill Reservoir a concrete retaining wall was built enclosing the basins. This wall being subjected to large variations in temperature, it was decided to make some investigations to determine the temperature changes in the concrete during and subsequent to setting. For this purpose three resistance bulbs for an electrical resistance thermometer were set in the concrete as it was placed.

The wall is 10 feet high, 18 inches thick and extends around the basins on top of the earth embankment. In the east wall three thermometers were placed; thermometer No. 1 was placed 3 inches from the east face; thermometer No. 2 was placed in the center, and thermometer No. 3 was placed 3 inches from the west face of the wall, all three thermometers being in the same vertical plane and 4 feet below the top of the wall. A thermometer, No. 4, was placed close to the wall by the other thermometers.

All the temperature readings in the concrete were taken with a Leeds & Northrup Electrical Resistance Thermometer; the temperatures of the air was taken with a mercury thermometer.

At the time of placing the concrete the air temperature was  $50^{\circ}$  F. and the temperature of the concrete was  $61^{\circ}$  F. During the first twenty-one hours, readings were taken every hour, after which readings were taken at three-hour intervals for a period of several days. In the thirteen hours immediately following the placing of the concrete the temperature gradually rose to  $68\frac{1}{4}^{\circ}$  F., while during the same period the air temperature fell to  $31^{\circ}$  F. In the next twenty-four hours the air temperature varied from  $31^{\circ}$  F. to  $57^{\circ}$  F., while the temperature of the concrete gradually fell to  $64\frac{1}{2}^{\circ}$  F. The thermometers nearer the face of the wall, *i. e.*, Nos. 1 and 3, were more affected by the outside temperatures than No. 2 in the center of the wall.

About 120 hours after the placing of the concrete the temperatures of the air and concrete followed each other more closely, although the

changes in the temperature of the concrete were somewhat slower than the variations in the air temperature.

Readings were taken at various intervals extending over a period of eleven months, readings being obtained for temperatures ranging from  $-16^{\circ}$  F. to  $106^{\circ}$  F. As these extreme temperatures lasted for only a comparatively short period of time, the difference between the corresponding concrete temperatures was somewhat less, namely,  $-10^{\circ}$  F. and  $100^{\circ}$  F., respectively, or a total variation of  $110^{\circ}$  F. in the concrete wall.

In Table No. 9 are shown the readings taken during the first forty-nine hours after placing of the concrete, and in Table No. 10 are shown the readings taken at various times under the extremes of temperature.

Respectfully,

F. R. WIEDERHOLDT,  
Assistant Engineer, Supply and Purifying Section.

TABLE No. 9.  
TEMPERATURES OF CONCRETE AND AIR.

Date	Time	Temperature Readings			
		No. 4 Outside	No. 1 East Face	No. 2 Center	No. 3 West Face
Feb. 21, 1917...	3:00 p. m.	58°	59°	58½°	58½°
" ...	3:15 p. m.	57°	59½°	62°	61°
" ...	4:15 p. m.	51°	59°	63°	61°
" ...	5:15 p. m.	48°	59½°	63°	61°
" ...	6:15 p. m.	44°	59½°	63°	61°
" ...	9:15 p. m.	38°	59½°	63¼°	60¾°
" ...	10:15 p. m.	38°	59½°	63¼°	60¾°
" ...	11:15 p. m.	38°	59½°	63½°	61°
Feb. 22, 1917...	12:15 a. m.	37°	59½°	63½°	61°
" ...	1:15 a. m.	35°	59¾°	64½°	61½°
" ...	2:15 a. m.	34°	60¾°	67¼°	63¼°
" ...	3:15 a. m.	33°	62°	68¼°	64¾°
" ...	4:15 a. m.	31°	63°	68¼°	65°
" ...	5:15 a. m.	31°	63°	68¼°	65°
" ...	6:15 a. m.	30°	63½°	68°	65°
" ...	8:15 a. m.	38°	63¼°	67°	65°
" ...	9:15 a. m.	42°	63¼°	66½°	64¼°
" ...	10:15 a. m.	42°	63¼°	66°	63¼°
" ...	11:15 a. m.	43°	63°	66°	63¾°
" ...	12:15 p. m.	46°	63°	66°	63¾°
" ...	3:15 p. m.	53°	63½°	65¼°	63¾°
" ...	6:15 p. m.	52°	63½°	65°	63¾°
" ...	9:15 p. m.	49°	63¼°	65°	64°
Feb. 23, 1917...	12:15 a. m.	52°	63¼°	64½°	63½°
" ...	3:15 a. m.	57°	63½°	64½°	63½°
" ...	6:15 a. m.	56°	63½°	64½°	64¼°
" ...	9:15 a. m.	52°	64°	64½°	64½°
" ...	12:15 p. m.	40°	63½°	64½°	63½°
" ...	4:15 p. m.	36°	61°	63°	61½°
Feb. 24, 1917...	8:00 a. m.	32°	51½°	53¾°	53¾°
" ...	12:00 p. m.	59°	51½°	52½°	51½°
Feb. 25, 1917...	11:00 a. m.	53°	45°	45°	45°
" ...	1:00 p. m.	63°	46½°	46°	46°
Feb. 26, 1917...	8:00 a. m.	60°	53½°	53½°	54°
" ...	12:00 p. m.	67°	56°	55°	55°

TABLE No. 10.  
TEMPERATURES OF CONCRETE AND AIR.

Date	Time	Temperature Readings			
		No. 4 Outside	No. 1 East Face	No. 2 Center	No. 3 West Face
June 25, 1917	8:00 a. m.	89°	88 $\frac{3}{4}$ °	86°	84°
"	9:00 a. m.	96°	92°	88°	84°
"	10:00 a. m.	99°	95 $\frac{1}{4}$ °	89 $\frac{3}{4}$ °	85°
"	11:00 a. m.	100°	96°	90 $\frac{1}{2}$ °	85 $\frac{1}{4}$ °
"	12:00 p. m.	101°	96 $\frac{1}{2}$ °	91 $\frac{3}{4}$ °	87°
"	1:00 p. m.	99°	96°	92 $\frac{1}{2}$ °	89°
"	2:00 p. m.	99°	94 $\frac{1}{2}$ °	93°	91°
"	3:00 p. m.	98 $\frac{1}{2}$ °	93 $\frac{1}{2}$ °	92 $\frac{1}{2}$ °	94 $\frac{1}{2}$ °
"	4:00 p. m.	96 $\frac{1}{2}$ °	93°	93 $\frac{1}{2}$ °	98°
"	5:00 p. m.	96°	92°	94°	101 $\frac{1}{2}$ °
"	6:00 p. m.	92 $\frac{1}{2}$ °	92 $\frac{1}{2}$ °	94 $\frac{1}{2}$ °	104°
"	7:00 p. m.	90 $\frac{1}{2}$ °	92 $\frac{3}{4}$ °	95 $\frac{1}{2}$ °	105 $\frac{1}{2}$ °
"	8:00 p. m.	89°	92 $\frac{1}{2}$ °	96°	104°
June 26, 1917	8:00 a. m.	96°	88 $\frac{1}{2}$ °	89 $\frac{1}{2}$ °	87°
"	9:00 a. m.	106°	96°	91°	88°
"	10:00 a. m.	106°	98 $\frac{3}{4}$ °	93°	88°
"	11:00 a. m.	102°	100°	95°	89°
"	12:00 p. m.	104°	100°	96°	90°
"	1:00 p. m.	104°	100°	96 $\frac{1}{2}$ °	92°
"	2:00 p. m.	101°	99°	97°	94 $\frac{1}{2}$ °
"	3:00 p. m.	101 $\frac{1}{2}$ °	98°	97°	96 $\frac{3}{4}$ °
"	4:00 p. m.	98°	97 $\frac{3}{4}$ °	97 $\frac{1}{4}$ °	100°
"	5:00 p. m.	94°	97°	98°	102°
"	6:00 p. m.	93°	96 $\frac{1}{2}$ °	98 $\frac{1}{2}$ °	104°
"	7:00 p. m.	90°	96°	98 $\frac{1}{2}$ °	105 $\frac{1}{2}$ °
Jan. 11, 1918	11:00 a. m.	-1°	10°	12 $\frac{1}{2}$ °	10°
Jan. 12, 1918	8:30 a. m.	-16°	-10°	-8°	-12°
"	9:30 a. m.	-11°	-11°	-7 $\frac{1}{2}$ °	-8°
"	10:30 a. m.	-8°	-8°	-6°	-6°
"	11:30 a. m.	-5°	-7 $\frac{1}{2}$ °	-5°	-5°
"	12:30 p. m.	-3°	-7°	-4 $\frac{1}{2}$ °	-4°

## SUPPLY AND PURIFYING SECTION.

## REPORT OF THE CHEMIST.

St. Louis, Mo., June 1st, 1918.

MR. CORNELIUS M. DAILY,  
Engineer-in-Charge.

DEAR SIR: I submit the following report on the operation of the Purification Plant for the year ending April 1st, 1918:

During the past year, 39,317 million gallons of water were pumped into the basins. To this amount of water were added 1,636 tons of sulphate of iron and 15,608 tons of lime, or an average of 0.58 grains per gallon of the former and 5.56 grains per gallon of the latter.

To the 39,373 millions of gallons of water filtered were added 1,922 tons of sulphate of alumina and 76,352 pounds of chlorine, or an average of 0.68 grains per gallon of the sulphate and 1.94 pounds per million gallons of the chlorine. The aluminum sulphate was added before, and the chlorine after, filtration.

The yearly maxima, minima and average of the sulphate of iron and lime used in grains per gallon since the installation of the process and the total quantities of lime and sulphate of iron used during the same period have been as follows:

YEAR	LIME				SULPHATE OF IRON				
	Grains per Gallon			Total Tons	Grains per Gallon			Total Tons	
	Maximum	Minimum	Average		Maximum	Minimum	Average		
1904-1905..	9.00	4.00	6.02	14,291	5.00	.....	1.52	3,578	
1905-1906..	10.00	5.00	6.28	11,814	5.00	.50	2.20	4,138	
1906-1907..	10.50	3.00	7.39	14,081	4.75	1.25	2.13	4,050	
1907-1908..	9.75	4.00	6.02	12,063	4.25	.....	2.55	5,117	
1908-1909..	8.00	4.75	5.58	11,611	4.25	1.75	2.41	5,013	
1909-1910..	8.25	4.50	5.70	13,044	4.50	1.50	2.91	6,649	
1910-1911..	7.25	4.00	5.77	13,032	4.00	1.75	2.70	6,098	
1911-1912..	8.50	.....	5.19	12,665	4.50	.....	3.35	8,094	
1912-1913..	6.50	4.00	5.23	12,448	4.50	1.75	2.97	7,082	
1913-1914..	7.50	4.25	5.63	12,871	4.25	1.00	2.49	5,816	
1914-1915..	7.50	4.00	5.75	13,660	4.50	1.25	3.00	6,770	
1915-1916..	7.25	3.50	5.57	13,790	3.75	.....	1.84	4,471	
1916-1917..	6.75	3.25	5.23	13,924	2.50	.....	0.71	1,910	
1917-1918..	8.00	4.00	5.64	15,608	2.50	.....	0.62	1,636	

The average cost per million gallons for lime was \$2.81, for sulphate of iron \$0.55, for sulphate of alumina, \$1.12 and for chlorine \$0.27. These costs are for chemicals alone and do not include the cost of handling or application. A comparison of the costs of the various

parts of the purification work done during the past five years, based on the quantity of water delivered to consumers, is shown in the following table:

### Cost Per Million Gallons, Based on Consumption.

	1913-1914	1914-1915	1915-1916	Nov., 1915, to April, 1916	1916-1917	1917-1918
<b>OLD PLANT</b>						
Lime .....	\$1.87	\$1.61	\$1.70	\$1.61	\$1.89	\$2.94
Iron .....	1.92	2.02	1.42	.64	.61	.57
Unloading .....	.11	.10	.08	.07	.08	.09
Operating, Maintenance and Repairs .....	.42	.35	.47	.51	.38	.41
Water, Coal, Oil, etc. ....	.05	.04	.03	.04	.03	.05
Light and Power .....	.04	.03	.07	.07	.04	.10
Chemical Work .....	.28	.25	.43	.49	.38	.34
Basin Cleaning .....	.07	.12	.14	.08	.12 (a)	.17
Basin Repairs .....			.03	.03	.01	.02
<b>Total Old Plant.</b>	<b>\$4.76</b>	<b>\$4.52</b>	<b>\$4.37</b>	<b>\$3.54</b>	<b>\$3.54</b>	<b>\$4.69</b>
<b>FILTERS.</b>						
Aluminum Sulphate .....			\$0.76	\$1.00	\$0.79	\$1.13
Chlorine .....			.18	.15	.14	.27
Operating, Maintenance and Repairs .....			.83	.98	.80	.77
Coal, Miscellaneous Supplies and Expenses .....			.14	.26	.20 (b)	.36
Light and Power .....			.14	.15	.11	.21
<b>Total.</b>			<b>\$6.42</b>	<b>\$6.08</b>	<b>\$5.58</b>	<b>\$7.43</b>
<b>Total Consumption for Year in Million Gallons.</b>	<b>30,927</b>	<b>33,971</b>	<b>32,583</b>	<b>13,138</b>	<b>35,633</b>	<b>38,090</b>
<b>COST OF CHEMICALS.</b>						
Lime, per ton, average 2 contracts .....	\$ 4.61	\$ 3.48	\$ 3.65		\$ 4.49	\$ 6.86
Sulphate of Iron, per ton, average .....	10.00	10.00	10.00		12.50	12.84
Sulphate of Alumina, per ton, average .....					21.00	22.25
Chlorine, per pound .....	.10	.10	.08		.13 $\frac{3}{8}$	.13 $\frac{3}{8}$

(a) Water used in basin cleaning included 1916-1917 and 1917-1918—Omitted other years.

(b) Water used in filter plant operation 1916-1917 and 1917-1918—Omitted other years.

The complete purification system was not in use until October, 1915. The heading, November, 1915-April, 1916, is included to show the costs of purification after the system was completed. These figures are included for the year 1915-1916.

Under the head of lime, iron, sulphate of alumina and chlorine are included all charges connected with the switching of these materials from the interchange tracks at Bissell's Point and Humboldt Avenue to the Chain of Rocks.

The sulphate of iron, in the form of sugar sulphate was furnished by the American Steel & Wire Co., at a price of \$12.50 per ton until July, after which the price was \$14.00.

Liquid chlorine, at a price of 13.375 cents per pound, was supplied by the Electro Bleaching Gas Co. The chlorine was delivered in cylinders containing 100 pounds.

Sulphate of alumina was purchased under the same specifications as last year. Basic sulphate of alumina containing not less than 17 per cent of available water soluble alumina,  $Al_2O_3$ , was required. It was furnished by the General Chemical Co. at a price of \$21.00 per ton until September 1st, 1917, and \$23.50 after that date.

Lime was purchased under a specification requiring a lime containing 85 per cent CaO with a bonus or penalty of  $1\frac{1}{2}$  per cent of the contract price for each per cent of CaO above or below the required 85 per cent. All lime was sampled as it came from the crusher after unloading and the samples together with the samples obtained from the daily supply hopper were analyzed in the laboratory.

Prior to this year annual contracts were made with the lime companies, but due to unusual conditions, the companies limited the time to three months. The Glencoe Lime & Cement Co. at \$7.50 a ton from July 1st to January 1st, and \$8.00 a ton since January first, and the Mississippi Sand Co. at \$7.58 from July 1st to January 1st, and \$8.08 per ton since January 1st, the contract expiring July 1st, 1918. The average price paid per ton on all deliveries since July from the former has been \$7.65, and from the latter \$7.76, from both \$7.70; the average per cent of lime present being 83.8. During a similar period last year the average price paid per ton was \$4.32, the average per cent of lime being 84.3.

The number of car and bin samples analyzed during each month together with the corresponding amounts of CaO per cent are given in the following table:

Lime Analyses—1917-1918.

MONTH	Car Samples Number of Cars	Per Cent Lime	Bin Samples Number of Samples	Per Cent Lime
April.....	52	86.7	30	86.7
May.....	27	82.9	31	84.9
June.....	40	83.1	29	82.3
July.....	55	83.2	31	82.5
August.....	43	83.0	22	85.0
September.....	43	81.3	14	82.8
October.....	47	83.8	31	84.1
November.....	30	86.0	30	85.7
December.....	31	85.6	14	86.6
January.....	53	81.9	27	83.3
February.....	20	82.2	28	81.8
March.....	43	78.9	33	80.2
Average.....		83.5		83.8

Of the 484 cars of lime received during the year seventy-two cars showed a percentage of lime greater than 90 per cent and 228 cars

greater than 85 per cent, the amount required by our specifications. The lowest percentage obtained was 59.9 per cent and the highest 95.5 per cent.

The work done in the Coagulant House has been mainly that of maintenance. The main line shaft has been equipped with 3-claw clutches, replacing the magnetic clutches which were in use, and the shafting proper, being badly worn, was completely renewed. The slaking and heater tanks, the lime storage and reclaim elevators have been overhauled and provided with the necessary new parts to put them in first class condition.

Due to the small amount of sulphate of iron used, comparatively little work has been necessary on the storage and reclaim elevators handling this chemical. A greater amount of work has been necessary in breaking up the hardened sulphate in the storage bins. A conveyor, in the basement, which would permit the return of the hardened sulphate to the iron crusher would lessen this work.

The milk of lime remaining in the slaking tanks at the end of a run was formerly drained into a sewer, but is now transferred to the tank to be put in service by means of a water jet pump. The estimated saving of lime in a year by this operation is 125 tons.

The 6-inch cast iron bell and spigot pipe lines carrying milk of lime have given the usual amount of trouble. Frequent leaks have occurred due to opening of the joints. The strength of the milk of lime as pumped is 38,600 parts per million of calcium oxide. The temperatures of the diluted milk of lime pumped through these lines are given below:

Lime Temperatures—1917-1918.

MONTH	Maximum	Minimum	Average
April.....	96	64	76
May.....	106	71	83
June.....	122	81	96
July.....	120	96	108
August.....	114	86	102
September.....	104	85	92
October.....	104	72	85
November.....	88	64	75
December.....	72	58	65
January.....	77	60	66
February.....	81	52	64
March.....	70	52	62
Average.....			81

The average stage of the Mississippi River at the Chain of Rocks, for the past year, was but slightly lower than for the previous year. The highest stage was 105.0' on June 14th, which was the highest stage since 1909. The lowest stage was 74.91' on December 30th.

The following table shows the number of tons removed each month of the suspended and dissolved matter present in our raw water. The coagulants precipitated as calcium carbonate, ferric hydroxide and aluminum hydroxide are also included:

### Suspended Matter, River Water, 1917-1918.

MONTH	Pumping Million Gallons Low Service	Suspended Matter Dissolved, Tons	Dissolved Matter Removed, Tons	Coagulants Precipitated, Tons	Total Matter Removed, Tons
April.....	2,901.91	42,438	786	1,974	45,198
May.....	3,132.30	31,480	915	2,209	34,604
June.....	3,232.80	53,859	944	2,638	57,441
July.....	3,743.11	58,392	1,265	3,197	62,854
August.....	3,594.32	27,978	899	2,637	31,514
September.....	3,145.35	12,110	1,353	2,052	17,567
October.....	3,026.72	9,466	1,513	1,963	12,972
November.....	2,969.21	7,181	1,485	1,896	10,562
December.....	3,449.74	11,039	1,863	2,074	14,976
January.....	4,013.01	1,339	2,109	2,411	5,859
February.....	3,133.81	11,420	1,176	2,561	15,161
March.....	2,975.14	44,725	684	1,972	47,381
Total...	39,317.42	311,427	14,992	27,584	356,089

The total amount of suspended matter removed was much higher than for the previous year, although the average stages of the river were practically the same. The stages varied more from the average than they did during the year 1916-1917.

The largest amount of suspended matter removed in one day was on April 20th, 1917, when 3,583 tons were deposited. The smallest amount removed was on January 3d, 1918, four tons being removed.

The number of tons of suspended matter deposited in the grit chamber for each month in the year is given below:

### Solids Removed by Grit Chamber, 1917-1918.

MONTH	Total Solids; Monthly Average Parts per Million			Low Service Pumping Mil- lion Gallons Total for Month	Tons of Solids Removed
	River Water	Water After Passage Through Grit Chamber	Removed by Grit Chamber		
April.....	3,750	2,570	1,180	2,901.91	14,297
May.....	2,680	2,145	535	3,132.3	6,985
June.....	4,190	3,370	820	3,232.81	11,056
July.....	4,000	3,170	830	3,743.11	12,951
August.....	2,100	1,770	330	3,594.32	5,060
September.....	1,210	1,020	190	3,145.35	2,492
October.....	1,070	960	110	3,026.73	1,392
November.....	940	790	150	2,969.21	1,657
December.....	760	550	210	3,449.74	3,014
January.....	510	460	50	4,013.01	837
February.....	1,300	770	530	3,133.81	6,926
March.....	3,800	1,325	2,475	2,975.14	30,703
Total.....				39,317.44	97,370

The grit chamber removed 31 per cent of the total suspended matter present in the river water. Over 50 per cent of this material is of such fineness that it will pass through a 100-mesh sieve. The matter deposited, amounting to 144,230 cubic yards, was flushed back into the river. The chamber was cleaned on an average of once a week, the periods between cleanings varying from four days to two weeks.

The lime was added, for the greater part of the year, to the raw water as it entered the mixing conduit and the sulphate of iron as the water left the conduit. The points of application of the milk of lime and sulphate of iron depend upon the condition of the raw water. With a water high in color and low in turbidity the iron is added before the lime with good results. If the high color is accompanied by a turbidity of 200 to 300 parts or more per million, better results are obtained by adding the sulphate of iron as the water leaves the mixing conduit. With high turbidity, the lime is always added at the first opening and the sulphate of iron at the last. With low color and low turbidity due to colloidal matter, the sulphate of iron is added at the third opening, which allows a mixing through one-half of the conduit.

The coating on the sides and bottoms of the mixing conduit have decreased instead of increasing as was expected. The unusually large amount of water passing through the conduit at times of maximum pumping, no doubt, was the cause of the removal of some of the coating.

Of the 353,980 tons of material removed from the water during the year by the grit chamber and purification processes, approximately 130,934 tons have been cleaned out in the usual manner with labor and teams. The remainder, excluding the sand removed by the grit chamber, has been flushed out through the sewers by opening the mud gates about six inches for a half-hour period at varying intervals and as the basins were drained for cleaning. The heavier matter can not be flushed out, 193,976 cubic yards of which have been removed during the year from 10 basins in sixteen cleanings at a cost of \$2,203.07.

The water used in cleaning, draining, flushing, etc., has approximated 870 million gallons, being divided as follows: Flushing, 207 million gallons; draining, 299 million gallons; cleaning, 364 million gallons. Filtered water, to the amount of 287 million gallons, was used in draining and cleaning and is included in the above given amounts.

The date of cleaning, amount of sediment, basins cleaned and costs of cleaning are given in the following table:

### Basin Cleaning Data, 1917-1918.

MONTH	CHAIN OF ROCKS								BADEN	
	Basin No. 1		Basin No. 2		Basin No. 6		Basin No. 9		Cu. Yds.	Cost
	Cu. Yds.	Cost	Cu. Yds.	Cost	Cu. Yds.	Cost	Cu. Yds.	Cost		
April.....	46200	\$457.22	25600	\$107.80	.....	.....	.....	.....	150	\$ 91.05
May.....	26400	160.80	.....	.....	.....	.....	.....	.....	150	52.70
July.....	.....	.....	.....	.....	.....	.....	23200	\$395.70	.....	.....
August.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
October.....	33000	166.55	.....	.....	37200	171.85	.....	.....	.....	.....
November.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Total.....	105600	\$784.57	25600	\$107.80	37200	\$171.85	23200	\$395.70	300	\$143.75

### Basin Cleaning Data, 1917-1918.

MONTH	BISSELL'S POINT								COMPTON HILL	
	Basin No. 1		Basin No. 2		Basin No. 3		Basin No. 4		S. Basin	
	Cu. Yds.	Cost	Cu. Yds.	Cost	Cu. Yds.	Cost	Cu. Yds.	Cost	Cu. Yds.	Cost
April.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
May.....	250	\$ 42.50	250	\$ 43.80	250	\$ 68.11	250	\$ 63.86	.....	.....
July.....	.....	.....	375	156.31	.....	.....	.....	.....	.....	.....
August.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
October.....	250	82.66	125	89.91	.....	.....	.....	.....	326	\$ 52.55
November.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Total.....	500	\$125.16	750	\$290.02	250	\$ 68.11	250	\$ 63.86	326	\$ 52.55

The cost per cubic yard of removing the mud from the sedimentation basins was 0.72 cents and from the clear water basins, 31.3 cents.

The costs given are for labor and teams only. No charge has been made for water used in drawing down, cleaning or flushing.

The presence of macroscopic and microscopic organisms, not bacteria, in our clear water basins has occasioned an unusual amount of trouble during the past year. It has been necessary to keep both of the south basins at Bissell's Point out of service for 140 days and the Baden basin for thirty days, because of the presence of organic growth in these basins.

The large amount of filtered water used in basin operation was due to frequent draining and cleaning of the clear water basins to rid them of the organisms, both macroscopic and microscopic, which infested the

water in these basins. Since the complete purification system has been in use the number of cleanings of the sedimentation basins have become less, but the reverse has been true of the clear water basins. The greater clearness of the water offers a better condition for the rapid growth and development of algae upon the side walls and bottoms of the basins.

The south basins at Bissell's Point can not be used during the summer months, the time when they are most needed. Because of the much greater consumption of water during this period, the basins should be in service, but their rapid befouling by the dust and offal from the cattle and other trains passing over the Merchants Bridge approach precludes their use at this time, because of the rapid multiplication of the organisms so introduced into the water.

The two north basins are kept comparatively free from these organisms by the rapid flow of the water through them when the two south basins are out of service. The rapid flow does not permit of their increase in these basins but does not prevent their development in the Compton Hill Reservoir where the flow through the basin is much slower and where the complete displacement of the water is not accomplished for some days. The presence of any of these organisms in Compton Hill is to be attributed principally to their introduction into the reservoir with the water from Bissell's Point, because there is but a small amount of dust blown into the reservoir and there is no soil washing to account for their presence.

The water in Compton Hill was in bad condition several times during the year, and the fact was attested by the numerous complaints of persons who had found, as they said, bugs, worms and green stuff in the water from the tap. The fact that a great many more complaints were not received, no doubt, is due to the consuming of these organisms unnoticed, and also because very few people are willing to go to the trouble of making a complaint. In getting samples in different parts of the city, it was always the case to find that not only the person making the complaint but people on either side, perhaps for the entire block, had noticed the condition causing the complaint.

The water in Compton Hill Reservoir, with the Bissell's Point and Baden basins covered, would, it is expected, always be in the condition in which it was sent from the Chain of Rocks filters: low in bacteria.

free from dust, suspended matter and macroscopic and microscopic organisms.

Both of the Compton Hill basins were treated with copper sulphate, one-third part per million, in September, at a time when the number of daphnia, or water-fleas, was very great. The corners of the basins received an additional treatment of copper sulphate, which caused large swarms of the fleas to come to the surface. A 400 cubic centimeter sample taken at this time showed the presence of about 100 large daphnia. The basins were kept out of service about five days after treatment, no daphnia being present at the end of that time. Two weeks later daphnia were again present, due, perhaps, to their being transported in the water from the basins at Bissell's Point.

The two south basins at Bissell's Point were treated with copper sulphate as was Basin No. 8 at the Chain of Rocks. A decided improvement in the quality of the water followed its use. The basins at Bissell's Point were visited for the first time by snails and by the larva of the dragon fly. Thousands of snails were daily skimmed from the basins during a period of a month. Besides the above ranatra quadridenta and the water beetles, aphodius fossar, hydrophilus piceus and dysticus marginalis were found. All of the above were found in Compton Hill Reservoir, and Baden basin but in lesser numbers. Diatoms, algae, protozoa, rotifera, crustacea, etc., were each represented in our clear water basins by a number of members of each class.

On May 14th, 1917, the break in the brick conduit between Baden and Bissell's Point occurred, and from that time until August 31st, when the water from the brick conduit was diverted to the new conduit, chlorine was added to the water at the terminal chamber at Bissell's Point. The number of pounds used during this period was 11,950.

The new 36-inch main from Bissell's Point to Compton Hill was sterilized by adding a total of approximately 100 pounds of hypochlorite at the manholes on the main. This amounted to seventy pounds per million gallons. The solution was allowed to remain in the main for eleven days, after which the main was cleaned by pumping through it for several hours. Twenty-six pounds of liquid chlorine were added at the suction end of the new turbine and the new main filled with chlorine-treated water. The amount of chlorine added amounted to eighteen pounds per million gallons.

A table showing the comparative turbidities of the river, settled, applied and filtered waters is given below :

### Comparative Turbidity, 1917-1918.

MONTH	River Water			Settled Water			Applied Water			Filtered Water			Water to Mains		
	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.
April .....	4220	1800	2460	110	15	37	22	9	13	0	0	0	0	0	0
May .....	3000	950	1610	58	4	25	27	5	13	0	0	0	0	0	0
June .....	5000	1850	3000	55	15	32	16	7	9	0	0	0	0	0	0
July .....	4220	1950	2650	55	10	22	15	7	9	0	0	0	0	0	0
August .....	1900	1000	1600	33	12	20	19	7	12	0	0	0	0	0	0
September ..	1250	500	820	20	9	13	18	8	11	0	0	0	0	0	0
October .....	1000	250	650	33	5	13	18	5	11	0	0	0	0	0	0
November ..	1000	150	510	32	6	14	29	4	8	0	0	0	0	0	0
December ..	600	45	210	32	10	16	13	4	7	0	0	0	0	0	0
January .....	40	8	18	65	11	33	20	4	12	0	0	0	0	0	0
February .....	525	12	250	100	7	34	35	3	10	0	0	0	0	0	0
March .....	1800	300	860	80	10	32	28	7	13	0	0	0	0	0	0
Average .....	.....	.....	1220	.....	.....	24	.....	.....	11	.....	.....	0	.....	.....	0

Although the turbidities of the river water were somewhat greater than for the previous year and a lesser amount of sulphate of iron was used, the turbidities of the settled water is but slightly greater and the turbidities of the applied water is the same. No turbid water was delivered to the mains at any time, as may be seen in the table. Sulphate of alumina was added to the influent flume for but one day during the year.

The color of the river, settled, applied and effluent waters are given in the following table :

### Color Removal, 1917-1918.

MONTH	River			Settled			Applied			Effluent		
	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.	Max.	Min.	Av.
April .....	31	20	25	26	12	15	24	11	14	16	8	11
May .....	34	25	29	23	14	17	19	11	15	14	9	12
June .....	29	21	27	19	14	17	16	11	13	12	9	11
July .....	28	22	24	18	12	15	14	10	12	11	8	10
August .....	22	20	21	17	12	15	14	10	12	9	7	9
September ..	22	17	20	16	10	13	13	9	11	10	7	9
October .....	19	15	18	13	9	11	11	8	9	9	7	8
November ..	19	12	14	12	6	9	9	5	7	7	4	6
December ..	18	12	14	11	7	8	8	6	7	7	4	6
January .....	19	10	15	15	7	11	12	6	9	10	5	7
February .....	45	17	24	39	9	17	28	7	13	24	5	10
March .....	35	17	31	32	16	23	26	13	18	23	11	16
Average .....	.....	.....	22	.....	.....	14	.....	.....	12	.....	.....	10

The color of the river water was very low during the past year, the maximum color obtained being 45 and the average 22. In the latter

part of February a rise in the Upper Mississippi and the Illinois Rivers gave us a highly colored water, with a turbidity of only 300 parts per million.

With high stages in the Mississippi and Illinois Rivers and a low stage in the Missouri, we encounter our worst condition for the treatment of the water. The high color of the Mississippi together with the colloidal matter in the Illinois made the water extremely hard to handle. The use of sulphate of iron as a coagulant at this time was accompanied by some difficulty. The coloring matter of the water combined with the iron and instead of a diminution in color, the color was increased. The suspended matter being really colloidal and some of the iron hydroxide remaining in the colloidal condition, the turbidity of the water after passing through the six sedimentation basins was greater than that of the river.

This highly colored and turbid water was much less amenable to treatment with sulphate of alumina. The amount of sulphate of alumina required to give the required flocculation of the suspended matter was four grains per gallon. With this large amount of sulphate, the water passing the filters was clear but still of high color, the iron content being eight to ten times as great as normally. No relief was experienced from this condition until the Missouri River run-off was increased and gave us a turbid water which offered enough suspended matter for the rapid subsidence of the floc of ferric hydroxide.

The total reduction in hardness, due to removal of part of the dissolved bicarbonate of calcium and magnesium present in the river water, was 84 parts per million. For every part per million of lime added there was a reduction in hardness of 0.87 part per million. Fifty-five per cent of the calcium and 47 per cent of the magnesium present in the river water were removed by the added lime.

This reduction in hardness of 84 parts per million means a saving in soap of 95 cents per 1,000 gallons of water used for washing purposes. This reduction in hardness also means the reduction of the scale forming solids from 1.3 pounds per 1,000 gallons in the river water to 0.7 pounds per 1,000 gallons in the water to mains.

## Total Hardness: River and Water to Mains.

Parts Per Million.

MONTH	River Water				Water to Mains			
	Number of Determinations	Maximum	Minimum	Average	Number of Determinations	Maximum	Minimum	Average
April.....	24	174	116	154	24	100	78	92
May.....	26	186	123	158	26	96	89	92
June.....	25	187	120	153	25	107	80	89
July.....	25	182	152	164	25	95	71	80
August.....	27	159	141	152	27	75	66	99
September..	24	196	161	173	24	89	70	78
October.....	26	228	173	196	26	121	83	97
November..	25	230	196	222	25	132	108	119
December..	25	300	200	250	25	161	107	134
January....	25	304	264	282	25	188	156	177
February...	22	296	144	220	22	179	113	140
March.....	26	167	142	156	26	114	96	105
Average....	.....	.....	.....	190	.....	.....	.....	106

The composite analyses of the raw water and water to mains are given in Table No. 18 (page 75).

The raw water composites were made up sometimes entirely of water obtained through the new intake, sometimes of water obtained through the old intake and sometimes were made up of mixtures of the two. The new intake was in service only ninety-seven days during the past year at a time when the ice in the river was rather heavy. The old intake was in use for 350 days. Because of the greater difficulty of treating the water from the new intake, this intake is not used unless low stages of the river or "Frazil" ice, or both, are affecting the pumping. The reduction in the total dissolved solids by our method of purification is considerable, amounting to about 750 pounds per million gallons. A study of Table No. 18 will show the great variations in the constituents of the raw water that has been handled during the year.

The results of weekly sanitary analyses of the river and tap waters are given in Table No. 17 (pages 74).

In the table on page 65 are given the number of bacteria on agar and gelatine in the river and the settled, applied and filtered waters and in the water to mains, and on agar alone in the water delivered to consumers. The average numbers of B. Coli in each is also given. More complete tables of the bacterial content of the water may be found on pages 76 to 85, inclusive.



The average numbers of bacteria on agar in the river water and water to mains are less than for the previous year, when the average of the river water was 8,200 and of the water to mains 11.

The per cent removal of the total number of 20° bacteria was 99.8 and of the 37° bacteria was 99.9

The water to consumers has been safe at all times during the year. No unusually high counts of bacteria were recorded. The count on agar is the lowest yet attained by this plant.

The number of chemical and bacterial analyses made during the year are shown by months in the following table:

**Number of Chemical and Bacteriological Tests Made  
During 1917-1918.**

MONTH	Bacteriological					Chemical
	Chain of Rocks	Taps	Swimming Pools	Filter Plant	Specials	
April.....	337	193	17	191	5	725
May.....	394	238	22	212	0	760
June.....	373	218	43	196	7	647
July.....	365	217	65	207	0	664
August.....	400	220	80	208	99	722
September.....	335	201	22	190	5	602
October.....	417	208	18	205	0	650
November.....	378	267	16	210	0	590
December.....	352	200	8	198	0	623
January.....	373	208	7	204	0	690
February.....	332	176	5	183	0	622
March.....	392	218	10	196	0	655
Total.....	4448	2564	313	2400	116	7950

Samples from fifteen swimming pools were obtained once a week, when the pools were in use, a total of 313 samples being examined and the results reported to the Health Commissioner. One hundred and sixteen well, spring and cistern samples, most of which were obtained in St. Louis County, were also analyzed at the request of the Health Commissioner, in an effort to determine the origin of the typhoid cases reported. The greater number of these samples gave positive results for B. Coli in ten and one cubic centimeters.

The following tables are appended:

Table 11. Summary of Monthly Variations in River Water, 1917-1918.

Table 12. Analyses of River Samples, 1917-1918.

Table 13. Analyses of Water Delivered to Mains, 1917-1918.

Table 14. Monthly Averages River and Water Delivered to Mains, 1917-1918.

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- Table 15. Turbidity and Color of River Water, 1917-1918.  
Table 16. Turbidity and Color of Water Delivered to Mains, 1917-1918.  
Table 17. Sanitary Analyses of River and Tap Water, 1917-1918.  
Table 18. Composite Analyses Raw and Water to Mains, 1917-1918.  
Table 19. Numbers of Bacteria in River Water, 1917-1918.  
Table 20. Numbers of Bacteria in Settled Water, 1917-1918.  
Table 21. Bacillus Coli in Settled Water, 1917-1918.  
Table 22. Numbers of Bacteria in Water Applied to Filters, 1917-1918.  
Table 23. Bacillus Coli in Water Applied to Filters, 1917-1918.  
Table 24. Numbers of Bacteria in Effluent Water, 1917-1918.  
Table 25. Bacillus Coli in Effluent Water, 1917-1918.  
Table 26. Numbers of Bacteria in Water to Mains, 1917-1918.  
Table 27. Bacillus Coli in Water to Mains, 1917-1918.  
Table 28. Bacteria in Water Delivered to Consumers, 1917-1918.  
Table 29. Quantities of Chemicals Applied, 1917-1918.  
Table 30. Operation Records for Chain of Rocks Filters, 1917-1918.  
Table 31. Cost Record for Chain of Rocks Filters, 1917-1918.

The report of Mr. August G. Nolte, Superintendent of the Filter Plant, is also appended.

Respectfully,

AUGUST V. GRAF,  
Chief Chemist.

TABLE No. 11. SUMMARY OF MONTHLY VARIATIONS IN RIVER WATER, 1917-1918.

	April	May	June	July	August	September	October	November	December	January	February	March	Fiscal Year
Stage in feet.....	95.2	97.5	105.0	93.8	85.7	81.4	80.1	79.7	79.2	83.0	84.2	89.2	105.0
Maximum.....	95.2	97.5	105.0	93.8	85.7	81.4	80.1	79.7	79.2	83.0	84.2	89.2	105.0
Minimum.....	88.3	87.4	92.1	85.9	79.2	79.2	78.9	79.1	77.3	73.4	80.0	82.6	74.9
Average.....	91.7	91.8	98.4	89.9	83.2	80.4	79.3	79.4	77.3	79.9	81.7	85.3	84.9
Turbidity:													
Maximum.....	4220	3000	5000	4220	1900	1250	1000	1000	600	40	625	1800	5000
Minimum.....	1800	950	1860	1950	1000	500	250	150	45	8	12	300	8
Average.....	2460	1610	3000	2650	1600	820	650	510	210	18	250	860	1220
Color:													
Maximum.....	31	34	29	28	22	22	19	19	18	19	45	35	45
Minimum.....	20	25	21	22	20	17	15	12	12	10	17	27	10
Average.....	25	29	27	24	21	20	18	14	14	15	24	31	22
Dissolved Solids:													
Maximum.....	310	350	340	310	250	320	370	410	440	460	468	282	468
Minimum.....	190	210	190	240	230	270	250	250	280	400	214	210	190
Average.....	250	270	260	260	240	290	320	360	380	430	350	250	300
Suspended Solids:													
Maximum.....	6930	4850	6340	5830	2360	1980	1000	800	930	320	2920	5600	6930
Minimum.....	1980	1410	2220	2460	1030	550	430	140	90	9	5	950	6
Average.....	3500	2410	3930	3740	1860	920	750	580	380	80	950	3550	1900
Alkalinity:													
Maximum.....	119	129	138	135	129	144	159	167	231	233	227	121	233
Minimum.....	96	93	89	121	108	120	132	155	157	209	106	100	89
Average.....	109	114	114	127	120	131	148	162	185	220	173	115	143
Bacteria on Gelatine at 20° C.:													
Maximum.....	210000	152000	170000	50000	40000	31500	68000	50500	27500	5400	340000	190000	340000
Minimum.....	49000	21200	18000	10000	5000	4000	9700	4800	2000	600	1500	18000	600
Average.....	96500	71000	56200	24000	18000	12600	17900	25000	11200	2700	79500	87400	41800
Bacteria on Agar at 37° C.:													
Maximum.....	16500	15700	20500	21500	27000	16000	23500	6000	1900	1050	15300	11550	27000
Minimum.....	1150	2000	5500	9500	5700	3900	4200	800	200	110	130	2075	110
Average.....	6500	6200	9700	15000	15000	8400	9500	2500	770	310	5470	5000	7030

Parts per Million.

WEEKLY	Turbidity	Color	Alkalinity	Non-Carbonate Hardness	Dissolved Solids	Suspended Solids	Calcium	Magnesium	Bacteria per c. c.		B. Coli per c. c. on Broth
									On Gelatine at 20° C.	On Agar at 37° C.	
April 7	1,900	29	100	23	230	2,070	28	13	79,000	4,200	6
14	1,950	24	105	50	260	1,990	38	15	120,000	2,000	5
21	3,750	20	120	55	265	6,500	45	15	200,000	9,100	8
28	2,500	22	115	43	255	4,040	41	14	120,000	11,500	6
May 5	2,100	28	95	28	210	2,360	33	10	86,000	11,500	10
12	1,500	27	105	49	265	2,170	41	13	59,000	3,700	5
19	1,000	29	125	48	275	1,570	45	14	110,000	2,500	1
26	950	30	125	52	310	1,440	46	14	67,000	4,800	9
June 2	3,400	23	125	52	315	5,890	47	15	100,000	5,900	80
9	4,100	25	100	37	230	5,030	39	15	83,000	15,000	70
16	1,900	27	100	35	200	2,700	38	10	170,000	9,200	40
23	2,250	29	120	40	270	2,600	43	13	30,500	6,500	20
30	2,750	27	135	46	300	3,880	50	14	31,500	6,400	40
July 7	2,750	25	133	41	300	3,830	47	14	33,500	17,900	30
14	2,800	24	127	44	270	3,910	44	14	13,500	11,500	60
21	2,400	25	128	35	260	3,240	44	13	13,000	13,000	30
28	2,150	23	122	35	245	2,810	41	13	21,500	18,000	10
Aug. 4	1,700	20	118	30	250	2,140	41	13	5,000	15,000	60
11	1,650	21	118	32	240	1,940	39	13	34,000	7,600	30
18	1,650	21	121	33	240	1,940	38	14	21,000	15,500	30
25	1,400	20	114	30	230	1,570	38	12	40,000	27,000	10
Sept. 1	1,000	21	126	37	265	920	41	14	17,000	8,400	40
8	1,100	20	120	44	280	1,980	43	14	28,000	9,900	50
15	800	21	127	42	285	1,345	45	14	10,500	9,900	20
22	800	20	135	48	312	1,094	48	16	6,500	7,300	1
29	500	17	144	52	320	680	51	17	4,000	8,500	10
Oct. 6	850	19	137	44	300	910	47	16	12,000	16,500	20
13	700	17	148	45	320	740	51	16	14,000	9,000	20
20	650	17	155	55	345	665	55	18	18,000	9,500	20
27	300	19	157	35	274	600	47	18	16,500	4,600	20
Nov. 3	600	16	157	61	360	600	54	20	48,000	4,600	10
10	500	15	161	59	355	485	55	20	25,000	1,600	20
17	500	12	165	54	370	540	57	23	23,500	2,300	10
24	550	12	166	60	360	665	58	19	28,000	3,000	10
Dec. 1	280	15	158	43	370	722	62	21	19,500	1,100	1
8	600	13	171	70	402	722	62	22	22,000	1,900	10
15	50	15	193	63	384	407	66	22	10,000	450	0
22	95	14	186	50	357	186	59	22	3,200	425	0.4
29	75	13	208	66	438	127	72	23	4,800	550	0.6
Jan. 5	25	11	225	63	439	36	73	26	4,200	110	0.4
12	25	13	230	74	462	323	76	28	2,000	140	0.9
19	10	17	212	58	415	30	68	25	2,400	130	0.8
26	16	19	218	56	428	30	67	25	2,300	130	0.9
Feb. 2	12	18	223	64	448	27	72	26	2,300	750	5.0
9	90	18	209	57	423	287	67	24	8,200	14,400	10.0
16	600	19	162	53	323	1,230	52	21	190,000	6,700	5.0
23	250	40	118	32	214	1,572	35	15	5,400	5,400	8.0
March 2	900	28	121	45	282	3,330	43	13	190,000	5,800	4.0
9	350	35	119	33	240	1,948	38	11	100,000	10,400	27.0
16	1,250	30	116	44	253	3,580	41	13	62,000	2,900	20.0
23	1,000	27	118	40	233	2,171	41	13	52,000	3,000	10.0
30	1,250	30	112	51	273	3,885	42	14			

TABLE No. 13. ANALYSES OF WATER DELIVERED TO MAINS, 1917-1918.

Parts per Million.

PERIOD WEEKLY	Color	Alkalinity	Phenol	Caustic + Bicarbon- ate —	Non- Carbonate Hardness	Dissolved Solids	Suspended Solids	Calcium	Magnesium	Iron, Total	Bacteria per c.c. on Agar 37° C.	Bacteria per c.c. on Gelatine 20° C.	B. Coli per 1 c.c.
April													
7	12	39	13	-13	45	165	0	22	7	.00	12	80	0
14	11	36	9	-18	52	170	0	20	9	.03	8	53	0
21	10	35	9	-17	63	200	0	23	10	.03	11	900	0
28	9	34	9	-16	65	195	0	24	9	.01	12	500	0
5	12	33	10	-13	55	195	0	24	7	.01	8	160	0
12	12	37	11	-15	53	195	0	24	7	.01	7	150	0
19	14	35	9	-17	60	190	0	24	8	.04	6	120	0
26	14	33	9	-15	57	200	0	23	8	.02	11	80	0
3	7	34	10	-14	65	230	0	29	6	.02	9	40	0
10	11	32	10	-12	65	220	0	30	5	.01	7	26	0
16	11	40	15	-10	155	180	0	30	2	.02	15	33	0
23	12	32	5	-22	55	210	0	27	6	.00	7	11	0
30	10	27	9	-17	65	200	0	28	4	.02	15	46	0
7	10	31	7	-13	55	200	0	24	5	.02	9	13	0
14	9	32	8	-16	51	185	0	21	5	.01	13	11	0
21	9	31	8	-15	43	170	0	21	5	.02	29	45	0
28	8	29	7	-18	43	165	0	20	5	.01	24	22	0
4	8	31	7	-17	36	155	0	18	5	.01	7	16	0
11	8	34	11	-10	34	150	0	17	6	.01	15	19	0
18	9	38	12	-16	35	160	0	18	6	.02	18	23	0
25	8	34	12	-11	35	155	0	18	6	.01	11	21	0
2	8	37	13	-10	33	170	0	16	9	.01	15	26	0
9	8	38	14	-14	38	195	0	17	9	.01	36	6	0
15	9	39	14	-11	39	176	0	17	9	.01	17	19	0
22	9	40	15	-12	35	175	0	18	12	.02	9	6	0
29	9	43	15	-13	45	195	0	16	9	.01	17	12	0
6	7	42	18	-12	48	202	0	17	11	.03	5	14	0
13	7	41	18	-5	51	202	0	18	13	.02	7	21	0
20	7	47	19	-22	37	163	0	14	15	.03	18	36	0
27	7	60	19	-19	69	235	0	14	20	.01	3	11	0
3	6	49	15	-19	72	252	0	18	19	.01	5	36	0
10	6	50	16	-18	73	243	0	17	19	.00	9	24	0
17	4	48	8	-32	73	241	0	17	17	.00	9	35	0
24	4	54	9	-36	58	241	0	19	17	.01	8	51	0
31	6	58	9	-40	60	260	0	17	17	.02	3	17	0
8	6	58	11	-36	68	212	0	24	21	.02	5	9	0
15	5	80	11	-58	58	262	0	24	22	.01	9	105	0
22	6	81	13	-55	52	246	0	20	22	.01	3	68	0
29	6	79	12	-55	63	319	0	28	24	.01	9	11	0
6	6	107	8	-91	63	280	0	27	24	.00	14	11	0
13	6	108	8	-92	58	314	0	34	25	.00	4	51	0
20	7	125	6	-113	63	311	0	31	25	.03	10	35	0
27	10	117	13	-103	61	320	0	29	26	.01	4	19	0
4	7	109	13	-83	69	320	0	24	23	.03	14	48	0
11	5	93	18	-57	63	258	0	22	20	.03	15	160	0
18	5	74	19	-36	64	188	0	21	15	.11	27	40	0
25	21	70	20	-30	43	192	0	28	12	.06	30	63	0
March													
2	15	47	12	-23	60	197	0	22	12	.20	25	90	0
9	21	51	18	-15	57	187	0	24	11	.04	16	200	0
16	16	50	17	-16	54	162	0	25	11	.02	16		0
23	16	40	14	-50	53	162	0	25	11	.02	16		0

TABLE No. 14. MONTHLY AVERAGES RIVER AND WATER DELIVERED TO MAINS, 1917-1918  
Parts per Million.

MONTH	Turbidity	Color	Suspended Solids	Dissolved Solids	Calcium	Magnesium	Alkalinity	Non-Carbonate Hardness	Bacteria per c. c. on Agar 37° C.	Bacteria per c. c. on Gelatine 20° C.	Number of B. Coli per c. c.
April.....River.....	2,460	25	3,500	250	38	14	109	45	6,500	96,500	5.9
To Mains.....	0	12	0	185	23	9	37	55	13	530	0.0044
May.....River.....	1,610	29	2,410	270	42	13	114	46	6,200	71,000	23.5
To Mains.....	0	12	0	200	24	8	35	57	10	105	0.0084
June.....River.....	3,000	27	3,930	260	42	12	114	41	9,700	56,200	36
To Mains.....	0	11	0	190	22	5	32	57	8	25	0.0037
July.....River.....	2,650	24	3,740	260	44	13	127	37	15,000	24,000	42
To Mains.....	0	10	0	180	23	5	30	50	13	14	0.0080
August.....River.....	1,600	21	1,860	240	39	13	120	32	15,000	18,000	32
To Mains.....	0	8	0	160	18	6	34	35	16	18	0.0038
September.....River.....	820	20	920	290	45	15	131	42	8,400	12,600	19
To Mains.....	0	8	0	180	17	9	39	39	15	19	0.0119
October.....River.....	650	18	750	320	50	17	148	48	9,500	17,900	20
To Mains.....	0	14	0	200	17	13	47	50	9	14	0.0039
November.....River.....	510	6	580	360	55	20	162	60	2,500	25,000	15
To Mains.....	0	14	0	240	17	19	53	66	6	26	0.0008
December.....River.....	210	14	380	380	62	22	185	60	770	11,200	4.3
To Mains.....	0	6	0	250	21	20	74	60	6	40	0.0036
January.....River.....	18	15	80	430	70	26	220	62	310	2,700	0.7
To Mains.....	0	7	0	300	30	24	114	60	5	50	0.0265
February.....River.....	250	24	950	350	56	21	173	50	5,470	79,500	5.0
To Mains.....	0	10	0	260	25	20	82	60	14	110	0.0331
March.....River.....	860	31	3,550	250	40	14	115	41	5,000	87,400	10.6
To Mains.....	0	16	0	195	24	11	50	55	24	90	0.0032
Average.....River.....	1,220	22	1,900	300	49	17	143	47	7,030	41,800	17.8
To Mains.....	0	10	0	210	22	12	52	54	11	87	0.0091

TABLE No. 15. TURBIDITY AND COLOR OF RIVER WATER, 1917-1918.

MONTH	Number of Test Days	Mean Turbidity	Turbidity							Number of Test Days	Mean Color	Variations in Numbers: Number of Test Days				
			Variations in Numbers: Number of Test Days									Variations in Numbers: Number of Test Days				
			50-150	151-500	501-1,000	1,001-2,000	2,001-3,000	3,001-4,000	4,001-5,000			10-20	21-30	31-40	41-50	Above 50
April.....	30	2460	0	0	0	11	14	4	1	25	25	1	24	0	0	
May.....	31	1610	0	0	5	19	7	0	0	29	4	0	23	0	0	
June.....	30	3000	0	0	0	6	12	7	5	27	0	0	25	0	0	
July.....	31	2650	0	0	0	2	25	3	1	25	0	0	25	0	0	
August.....	31	1600	0	0	0	31	0	0	0	27	0	7	20	0	0	
September.....	30	820	0	3	23	4	0	0	0	14	10	0	10	0	0	
October.....	31	650	0	5	25	1	0	0	0	26	18	0	26	0	0	
November.....	30	510	1	14	15	0	0	0	0	25	14	0	0	0	0	
December.....	31	210	19	6	6	0	0	0	0	25	14	0	0	0	0	
January.....	29	18	29	0	0	0	0	0	0	25	15	0	0	0	0	
February.....	28	250	11	12	5	0	0	0	0	22	24	2	2	3	0	
March.....	31	860	0	7	14	10	0	0	0	26	31	0	14	12	0	
Total.....	363	.....	60	47	93	84	58	14	7	302	.....	138	143	19	2	
Average.....	.....	1220	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
Per cent Times.....	.....	.....	16.5	13.0	25.6	23.2	15.9	3.9	1.9	.....	.....	45.6	47.5	6.3	0.6	
Per cent Times.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	

TABLE No. 16. TURBIDITY AND COLOR OF WATER DELIVERED TO MAINS, 1917-1918.

MONTH	Turbidity				Color				
	Number of Test Days	Mean Turbidity	Variations No. of Test Days		Number of Test Days	Mean Color	Variations No. of Test Days		
			0-10	Above 10			5-10	11-20	Above 20
April.....	24	0	24	0	24	12	7	17	0
May.....	26	0	26	0	26	12	4	22	0
June.....	25	0	25	0	25	11	6	19	0
July.....	25	0	25	0	25	10	24	1	0
August.....	27	0	27	0	27	8	27	0	0
September..	24	0	24	0	24	8	24	0	0
October....	26	0	26	0	26	8	26	0	0
November..	25	0	25	0	25	6	25	0	0
December..	25	0	25	0	25	6	25	0	0
January....	25	0	25	0	25	7	25	0	0
February..	22	0	22	0	22	10	17	2	3
March.....	26	0	26	0	26	16	1	22	3
Total.....	300	.....	300	0	300	.....	211	83	6
Average.....	.....	0	.....	.....	.....	10	.....	.....	.....
Per cent Times.....	.....	.....	100	0	.....	.....	70.2	27.6	2.2

TABLE No. 17. SANITARY ANALYSES OF RIVER AND TAP WATER, 1917-1918.

	Dissolved Solids				Suspended Solids				Oxygen Consumed				NITROGEN								Chlorine as Chlorides				Alkalinity as CaCO <sub>3</sub>				River Stage Market Street				
													As Ammonoid Ammonia				As Nitrites				As Nitrates												
	River	Tap	River	Tap	River	Tap	River	Tap	River	Tap	River	Tap	River	Tap	River	Tap	River	Tap	River	Tap	River	Tap	River	Tap	River	Tap	River	Tap		River	Tap		
April 5.....	205	187	2230	0	35.8	2.5	0	200	1.60	200	.02	.048	1.0	1.200	9	7	40	95	40	19.6	36	16.4											
12.....	260	184	2239	0	36.4	3.0	0	100	.080	160	.016	.016	.800	.800	8	8	36	106	36	16.4	31	16.4											
19.....	269	202	2587	0	36.4	3.7	0	100	.080	160	.016	.002	.600	.400	10	7	116	116	31	20.5	32	22.3											
26.....	278	235	3125	0	34.6	2.1	0	160	.080	160	.016	.000	.900	.400	6	6	112	112	33	22.5	33	23.5											
3.....	278	201	2777	0	38.4	3.6	0	160	.080	160	.024	.000	1.000	.800	6	5	97	97	36	23.1	36	23.5											
10.....	247	206	2270	0	30.5	3.2	0	200	.040	200	.014	.000	1.000	1.200	6	5	106	106	31	16.8	31	16.8											
17.....	280	194	1665	0	20.2	2.2	0	100	.040	160	.006	.000	.400	.400	9	6	124	124	34	14.8	34	14.8											
24.....	295	213	2055	0	22.3	2.3	0	160	.040	160	.010	.000	.400	.400	12	9	128	128	32	19.8	32	19.8											
31.....	346	213	4844	0	59.2	4.4	0	200	.040	200	.012	.000	1.000	1.000	7	7	118	118	30	26.0	30	26.0											
June 14.....	261	176	2822	0	36.8	2.6	0	160	.040	160	.010	.000	.800	.600	5	5	90	90	34	32.9	34	32.9											
21.....	228	173	2846	0	36.0	2.9	0	160	.040	160	.014	.000	.800	.400	6	6	132	132	27	21.9	27	21.9											
28.....	294	202	3782	0	31.5	2.6	0	160	.040	160	.004	.000	.800	.400	9	7	130	130	32	19.3	32	19.3											
July 5.....	295	208	4030	0	45.0	3.3	0	160	.040	160	.002	.000	.800	.400	7	7	129	129	29	19.3	29	19.3											
12.....	258	194	4257	0	35.8	3.3	0	200	.040	200	.002	.000	.800	.400	7	7	123	123	31	15.8	31	15.8											
19.....	257	171	4123	0	34.2	2.6	0	160	.040	160	.001	.000	.400	.400	6	6	127	127	29	14.0	29	14.0											
26.....	246	169	3240	0	39.5	2.9	0	160	.040	160	.002	.000	.800	.600	6	6	123	123	27	11.4	27	11.4											
Aug. 2.....	245	168	2277	0	31.7	2.3	0	160	.040	160	.001	.000	.800	.600	9	7	119	119	33	8.8	33	8.8											
9.....	236	153	2048	0	22.5	2.3	0	160	.040	160	.002	.000	.800	.600	11	11	120	120	40	8.4	40	8.4											
16.....	238	161	2768	0	29.6	2.5	0	160	.040	160	.001	.000	.200	.200	13	12	117	117	33	7.2	33	7.2											
23.....	233	150	1821	0	28.0	1.8	0	160	.040	160	.001	.000	.500	.500	9	9	122	122	37	5.2	37	5.2											
30.....	245	158	1025	0	29.0	2.2	0	160	.040	160	.002	.000	.800	.600	12	11	128	128	39	4.3	39	4.3											
Sept. 6.....	281	175	909	0	16.8	2.1	0	160	.020	160	.002	.000	.400	.400	13	12	130	130	37	3.5	37	3.5											
13.....	276	177	831	0	14.3	2.0	0	160	.020	160	.000	.000	.400	.400	13	11	130	130	40	3.5	40	3.5											
20.....	278	189	880	0	23.2	2.4	0	160	.040	160	.004	.000	.600	.600	12	12	142	142	43	2.8	43	2.8											
27.....	312	197	722	0	22.4	2.4	0	160	.040	160	.001	.000	.600	.600	12	12	142	142	43	2.8	43	2.8											
Oct. 4.....	295	214	969	0	18.8	2.1	0	160	.040	160	.000	.000	.600	.600	12	13	146	146	42	2.2	42	2.2											
11.....	305	212	755	0	19.2	1.8	0	160	.040	160	.002	.000	.600	.600	12	13	146	146	42	2.2	42	2.2											
18.....	359	227	721	0	12.8	2.0	0	160	.020	160	.000	.000	.600	.600	19	18	154	154	47	1.8	47	1.8											
25.....	270	194	504	0	13.6	2.5	0	160	.020	160	.001	.000	.800	.800	9	8	156	156	56	2.1	56	2.1											
Nov. 1.....	366	224	653	0	14.0	2.6	0	160	.060	160	.001	.000	.600	.600	15	15	159	159	51	2.1	51	2.1											
8.....	360	244	522	0	16.0	2.6	0	160	.060	160	.001	.000	.600	.600	15	15	160	160	51	2.9	51	2.9											
15.....	395	188	516	0	14.8	2.6	0	160	.060	160	.001	.000	.800	.800	15	13	165	165	58	3.0	58	3.0											
22.....	374	250	501	0	25.3	2.4	0	160	.040	160	.001	.000	.600	.600	16	15	164	164	51	2.7	51	2.7											
29.....	289	267	501	0	20.3	2.3	0	160	.040	160	.001	.000	.600	.600	16	15	157	157	59	2.4	59	2.4											
Dec. 6.....	387	184	777	0	25.3	3.3	0	100	.060	160	.002	.000	.600	.600	18	18	169	169	61	2.0	61	2.0											
13.....	380	272	310	0	13.9	3.4	0	160	.080	160	.003	.000	.600	.600	18	18	190	190	71	2.9	71	2.9											
20.....	357	272	156	0	17.4	3.4	0	160	.080	160	.002	.000	.600	.600	15	15	185	185	70	0.3	70	0.3											
27.....	382	223	91	0	14.4	3.4	0	160	.080	160	.001	.000	.800	.800	14	14	195	195	78	1.0	78	1.0											
Jan. 3.....	442	309	91	0	21.9	4.3	0	160	.100	160	.002	.000	.600	.600	22	25	222	222	101	2.2	101	2.2											
10.....	446	300	177	0	8.5	2.8	0	100	.100	160	.003	.000	.400	.400	26	21	221	221	108	0.2	108	0.2											
17.....	420	271	191	0	10.4	2.8	0	120	.080	160	.000	.000	.400	.400	19	19	211	211	118	5.1	118	5.1											
24.....	435	293	72	0	10.0	4.0	0	120	.080	160	.002	.000	.400	.400	16	16	218	218	125	5.2	125	5.2											
31.....	451	300	114	0	13.1	3.4	0	120	.080	160	.001	.000	.600	.600	22	19	222	222	110	3.6	110	3.6											
Feb. 7.....	468	303	95	0	11.7	3.8	0	160	.120	160	.003	.000	.400	.400	22	20	226	226	98	.....	98	.....											
14.....	380	263	1303	0	7.6	2.4	0	160	.080	160	.003	.000	.400	.400	39	16	172	172	81	3.8	81	3.8											
21.....	244	225	1914	0	20.6	3.3	0	160	.120	160	.004	.000	.600	.600	40	8	143	143	69	8.9	69	8.9											
28.....	298	185	1773	0	15.8	3.6	0	160	.160	160	.004	.000	.600	.600	12	8	124	124	57	10.5	57	10.5											
March 7.....	222	222	1832	0	14.9	6.7	0	160	.160	160	.003	.001	.600	.600	40	10	117	117	56	10.7	56	10.7											
14.....	268	204	3090	0	24.1	4.2	0	160	.120	160	.003	.000	.800	.800	10	10	120	120	46	11.7	46	11.7											
21.....	268	191	2714	0	24.1	4.2	0	160	.120	160	.004	.001	.800	.800	8	8	120	120	46	11.7	46	11.7											

TABLE No. 18. COMPOSITE ANALYSES, RAW AND WATER TO MAINS, 1917-1918.  
Results in Parts per Million.

PERIODS 1917-1918	Silica SiO <sub>2</sub>		Insoluble		Fe <sub>2</sub> O <sub>3</sub> and Al <sub>2</sub> O <sub>3</sub>		Calcium Ca		Mag- nesium Mg.		Sod. and Pot.		Bi- carbonate HCO <sub>3</sub>		Sulphate SO <sub>4</sub>		Chlorine Cl.		Nitrates NO <sub>3</sub>		Dissolved Solids		Total Solids	
	Raw	To Mains	Raw	To Mains	Raw	To Mains	Raw	To Mains	Raw	To Mains	Raw	To Mains	Raw	To Mains	Raw	To Mains	Raw	To Mains	Raw	To Mains	Raw	To Mains	Raw	To Mains
April																								
2-7 and 9-14	11	9	0.6	0.6	0.6	2.2	34	21	13	8	23	20	126	21	65	66	8	9	4.0	4.1	230	170	2,490	170
16-21 and 23-28	10	10	0.6	0.6	0.6	2.8	43	23	15	10	31	24	140	21	83	91	8	8	3.2	2.3	270	200	4,800	200
30, May 5 and 7-12	7	7	0.6	1.0	0.6	2.8	37	24	11	7	23	26	122	17	63	96	7	8	4.9	4.4	240	200	3,260	200
May																								
14-19 and 21-26	9	9	0.2	0.0	0.6	2.8	45	24	15	8	23	25	149	21	94	90	8	8	3.1	3.1	280	190	2,030	190
28, June 2 and 4-9	8	8	0.2	0.2	0.4	2.8	45	28	13	6	32	31	148	17	93	100	10	12	3.5	3.5	290	230	5,340	230
June																								
11-16 and 18-23	11	9	0.0	0.0	0.2	2.6	38	28	11	4	20	18	126	20	56	74	6	7	3.5	3.5	220	170	3,300	170
23-30 and July 2-7	9	7	0.0	0.0	0.2	2.6	48	27	14	6	31	26	160	22	86	98	8	8	2.7	1.8	300	200	4,180	200
July																								
9-14 and 16-21	13	9	0.0	0.0	0.2	2.6	44	23	13	5	26	26	156	15	70	82	8	8	2.7	2.7	260	180	4,230	180
6-11 and 13-18	12	8	0.4	0.6	0.0	2.2	42	20	13	3	23	23	153	16	56	73	8	10	2.2	1.8	230	160	3,000	160
Aug.																								
23-28 and 30, Aug. 4	12	8	0.0	0.0	0.2	2.4	39	17	13	6	24	21	146	18	53	61	10	12	2.9	2.4	240	160	2,290	160
20-25 and 27, Sept. 1	9	8	0.6	0.0	0.2	2.2	39	18	13	6	23	23	145	16	51	58	12	12	1.8	1.3	280	180	1,700	160
Sept.																								
3-8 and 10-15	12	8	0.4	0.4	0.0	2.6	44	17	14	8	29	25	156	13	70	70	13	12	3.1	2.2	280	180	1,320	180
17-22 and 24-29	12	9	0.8	0.4	0.0	2.0	47	17	15	9	29	27	165	13	72	74	13	13	2.7	1.5	290	190	1,120	190
Oct.																								
1-6 and 8-13	12	11	0.6	0.4	0.2	1.4	49	18	11	32	33	33	171	9	84	86	17	16	2.7	1.5	310	200	1,160	200
15-20 and 22-27	8	10	0.4	0.4	0.2	1.4	50	16	18	14	32	33	188	21	99	94	15	15	3.1	2.7	310	210	950	210
29, Nov. 3 and 5-10	12	8	0.2	0.2	0.8	1.4	54	16	21	19	38	33	194	26	109	109	15	14	2.7	1.8	360	230	970	230
Nov.																								
12-17 and 19-24	8	6	0.0	0.2	0.2	1.8	55	16	21	18	36	31	195	34	109	109	15	14	3.5	3.1	360	230	900	230
26, Dec. 1 and 3-8	9	8	0.2	0.0	0.4	2.0	56	18	20	17	37	33	201	45	93	95	15	13	3.1	2.2	350	230	1,040	230
Dec.																								
12-17 and 17-22	12	11	0.0	0.0	0.4	1.2	63	23	22	21	38	38	232	71	99	110	18	18	2.7	2.7	380	270	710	270
24-29 and 31, Jan. 5	12	9	0.0	0.0	0.4	1.6	68	29	24	22	41	36	254	84	92	99	20	17	3.1	2.2	410	270	580	300
Jan.																								
7-12 and 14-19	9	10	0.0	0.0	0.4	1.8	69	31	26	24	40	42	266	121	89	81	19	19	2.2	2.2	420	300	580	300
21-26 and 28, Feb. 2	15	12	0.2	0.2	0.4	1.8	69	31	26	25	39	35	265	122	89	81	19	19	2.2	2.2	410	300	950	300
Feb.																								
4-9 and 11-16	16	15	0.2	0.0	0.6	3.0	41	25	16	14	26	27	155	35	53	73	11	13	2.7	2.6	260	200	2,070	200
18-23 and 25, March 2	8	7	0.2	0.0	0.4	2.0	39	24	12	26	28	24	142	24	60	82	11	11	3.1	2.6	250	200	2,700	200
March																								
4-9 and 11-16	9	8	0.2	0.0	0.6	2.0	39	24	12	26	28	24	142	24	60	82	11	11	3.1	2.6	250	200	2,700	200
18-23 and 25-30	10	10	0.0	0.0	0.4	1.0	40	22	14	11	25	25	140	23	72	72	9	9	3.1	3.1	250	190	2,900	190
Average	11	9	0.3	0.2	0.4	2.1	49	22	17	12	31	29	175	35	78	85	13	13	2.9	2.5	300	210	2,200	210

TABLE No. 19. NUMBER OF BACTERIA IN RIVER WATER, 1917-1918.

MONTH	On Gelatine at 20° C.										On Agar at 37° C.												
	No. of Test Days	Mean per c.c.	Median per c.c.	Variations in Numbers: Number of Test Days						No. of Test Days	Mean per c.c.	Median per c.c.	Variations in Numbers: Number of Test Days										
				0-500	501-1,000	1,001-10,000	10,001-25,000	25,001-50,000	50,001-100,000				Above 100,000	0-100	101-500	501-1,000	1,001-5,000	5,001-10,000	10,001-20,000	20,001-30,000	Above 30,000		
April.....	24	96,500	73,250	0	0	0	0	0	16	8	24	6,500	6,575	0	0	0	9	14	1	0	24	6,500	
May.....	26	71,000	63,250	0	0	0	1	4	18	3	26	6,200	4,825	0	0	0	14	7	5	0	26	6,200	
June.....	25	56,200	46,500	0	0	0	3	13	7	2	25	9,700	8,200	0	0	0	0	16	8	1	0	25	9,700
July.....	25	24,000	21,500	0	0	1	16	8	0	0	25	15,000	13,250	0	0	0	0	1	23	1	0	25	15,000
August.....	27	18,000	15,750	0	0	2	20	5	0	0	27	15,000	15,000	0	0	0	0	4	20	3	0	27	15,000
September.....	24	12,600	9,880	0	0	12	9	3	0	0	24	8,400	8,150	0	0	0	2	19	3	0	0	24	8,400
October.....	26	17,900	13,750	0	0	3	10	2	1	0	26	9,500	8,350	0	0	0	4	14	6	2	0	26	9,500
November.....	25	25,000	25,000	0	0	13	11	1	1	0	25	2,500	2,150	0	12	6	23	1	0	0	0	25	2,500
December.....	25	11,200	10,000	0	0	0	1	1	0	0	25	770	550	0	23	1	7	0	0	0	0	25	770
January.....	24	2,700	2,475	0	1	23	0	0	0	0	23	5,470	4,800	0	6	2	3	7	4	0	0	23	5,470
February.....	19	79,500	51,000	0	0	9	0	0	5	5	19	5,000	4,125	0	0	0	16	7	3	0	0	19	5,000
March.....	25	87,400	79,500	0	0	0	1	7	8	9	26	5,000	4,125	0	0	0	16	7	4	0	0	26	5,000
Total.....	295	.....	.....	0	1	64	93	54	56	27	300	.....	.....	0	41	10	79	90	73	7	0	300	.....
Average.....	.....	41,800	34,300	.....	.....	.....	.....	.....	.....	.....	.....	7,030	6,520	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Per cent times...	.....	.....	.....	0	0.3	21.7	31.6	18.3	19.0	9.1	.....	.....	.....	0	13.6	3.3	26.4	30.0	24.4	2.3	0	.....	.....

TABLE No. 20. NUMBER OF BACTERIA IN SETTLED WATER, 1917-1918.

MONTH	On Gelatine at 20° C.											On Agar at 37° C.										
	No. of Test Days	Mean per c.c.	Median per c.c.	Variations in Numbers: No. of Test Days							No. of Test Days	Mean per c.c.	Median per c.c.	Variations in Numbers: No. of Test Days								
				0-25	26-50	51-100	101-250	251-500	501-1000	Above 1000				0-10	11-25	26-50	51-100	101-250	251-500	Above 500		
April.....	24	2,130	963	0	0	0	1	5	6	12	70	62	0	0	7	13	4	0	0			
May.....	25	3,100	3,450	0	0	0	2	4	2	17	66	50	0	0	13	9	3	0	0			
June.....	25	690	250	0	2	2	11	4	2	6	75	75	0	0	3	20	2	0	0			
July.....	25	145	90	1	5	8	9	1	0	1	85	66	0	1	8	8	7	1	0			
August.....	27	83	63	0	11	8	8	0	0	0	83	73	0	0	9	8	9	0	0			
September.....	23	59	55	1	10	10	2	0	0	0	57	51	0	1	11	11	1	0	0			
October.....	26	170	113	0	4	8	8	5	1	0	70	55	0	1	11	8	6	0	0			
November.....	25	375	313	0	0	0	7	13	5	0	38	40	0	5	17	3	0	0	0			
December.....	25	340	300	0	0	0	10	13	2	0	40	32	0	4	19	1	1	0	0			
January.....	25	560	450	0	0	0	3	10	9	3	49	44	0	4	12	8	2	0	0			
February.....	19	3,040	2,000	0	0	0	0	3	4	12	370	183	0	2	6	0	5	2	7			
March.....	26	880	694	0	0	0	0	4	15	7	190	163	0	0	0	10	9	7	0			
Total.....	295	.....	.....	2	30	36	61	62	46	58	.....	.....	0	19	116	99	49	10	7			
Average.....	.....	960	730	.....	.....	.....	.....	.....	.....	.....	100	75	.....	.....	.....	.....	.....	.....	.....			
Per cent times.....	.....	.....	.....	0.7	10.2	12.2	20.7	21.0	15.6	19.6	.....	.....	0	6.4	38.6	33.0	16.4	3.3	2.3			

TABLE No. 21. BACILLUS COLI IN SETTLED WATER, 1917-1918.

MONTH	Bacillus Coli								B. Coli Index No. per c.c.		
	No. of Test Days	0.1 c.c.		1 c.c.		10 c.c.		% +			
		Total No.	No. +	% +	Total No.	No. +	% +			Total No.	No. +
April.....	24	88	0	0.0	88	6	6.8	44	10	22.7	0.0839
May.....	26	96	2	2.1	96	14	14.6	44	20	41.7	0.3621
June.....	25	90	0	0.0	90	1	1.1	45	8	17.8	0.0277
July.....	25	92	2	2.2	92	10	10.9	46	14	30.4	0.3265
August.....	27	100	0	0.0	100	2	2.0	50	13	26.0	0.0440
September.....	24	86	0	0.0	86	0	0.0	43	9	20.9	0.0209
October.....	26	94	0	0.0	94	8	8.5	47	30	63.8	0.1403
November.....	25	88	3	3.4	88	13	14.8	41	27	61.4	0.5006
December.....	25	84	1	1.2	84	13	13.1	42	28	66.7	0.2926
January.....	26	94	3	3.2	94	41	43.6	47	43	91.5	0.7719
February.....	22	80	2	2.5	80	21	26.2	40	35	77.5	0.5133
March.....	26	94	1	1.1	94	4	4.3	47	24	51.1	0.1888
Total.....	301	1086	14	.....	1086	131	.....	543	261	.....	.....
Average.....	.....	.....	.....	1.3	.....	.....	12.1	.....	.....	47.3	0.2732

TABLE No. 22. NUMBERS OF BACTERIA IN WATER APPLIED TO FILTERS, 1917-1918.

MONTH	On Gelatine at 20° C.													On Agar at 37° C.						
	No. of Test Days	Mean per c.c.	Median per c.c.	Variations in Numbers: Number of Test Days							No. of Test Days	Mean per c.c.	Median per c.c.	Variations in Numbers: Number of Test Days						Above 500
				0-25	26-50	51-100	101-250	251-500	501-1,000	Above 1,000				0-10	11-25	26-50	51-100	101-250	251-500	
April.....	24	1,500	594	0	0	0	2	10	2	10	24	43	39	0	5	14	5	0	0	0
May.....	26	2,300	2,075	0	0	0	4	17	1	17	26	46	43	0	3	15	8	0	0	0
June.....	25	320	180	0	1	6	11	2	3	2	25	39	39	0	3	19	3	0	0	0
July.....	25	60	48	1	12	11	1	0	0	0	25	42	37	0	6	13	5	1	0	0
August.....	27	65	45	4	11	7	5	0	0	0	27	52	51	0	8	5	13	1	0	0
September.....	23	53	48	3	12	7	1	0	0	0	24	48	45	0	1	11	8	0	0	0
October.....	26	170	134	0	2	7	12	5	0	0	26	69	59	0	3	11	10	2	0	0
November.....	25	260	253	0	0	1	11	12	1	0	25	24	22	0	18	6	1	0	0	0
December.....	25	240	245	0	0	0	13	12	0	0	25	22	20	1	18	6	0	0	0	0
January.....	25	420	413	0	0	0	5	13	6	1	26	31	25	0	14	9	3	0	5	1
February.....	18	1,870	1,125	0	0	0	0	8	1	9	22	160	89	0	6	2	3	3	5	1
March.....	26	1,200	570	0	0	0	0	12	6	8	26	110	93	0	0	6	8	11	1	0
Total.....	295	.....	.....	8	38	39	65	78	20	47	301	.....	.....	1	85	121	67	20	6	1
Average.....	.....	700	478	.....	.....	.....	.....	.....	.....	.....	.....	56	46	.....	.....	.....	.....	.....	.....	.....
Per cent times.....	.....	.....	.....	2.7	12.9	13.2	22.0	26.5	6.8	15.9	.....	.....	.....	0.3	23.2	40.2	22.3	6.7	2.0	0.3

TABLE No. 23. BACILLUS COLI IN WATER APPLIED TO FILTERS, 1917-1918.

MONTH	Bacillus Coli*										B. Coli Index No. per c.c.
	No. of Test Days	0.1 c.c.			1 c.c.			10 c.c.			
		Total No.	No. +	% +	Total No.	No. +	% +	Total No.	No. +	% +	
April . . . . .	24	88	0	0.0	88	1	1.1	44	6	13.6	0.0235
May . . . . .	26	96	3	3.1	96	7	7.3	48	17	33.3	0.378
June . . . . .	25	90	0	0.0	90	3	3.3	45	13	28.9	0.0586
July . . . . .	26	92	0	0.0	92	2	2.2	46	11	23.9	0.0437
August . . . . .	27	100	0	0.0	100	6	6.0	50	11	22.0	0.0760
September . . . . .	24	86	1	1.2	86	3	3.5	43	19	44.2	0.1837
October . . . . .	26	94	2	2.1	94	14	14.9	47	32	66.1	0.3912
November . . . . .	25	88	1	1.1	88	9	10.2	44	30	68.2	0.2710
December . . . . .	25	86	3	3.5	86	13	15.1	43	33	76.7	0.5276
January . . . . .	26	94	5	5.3	94	41	43.6	47	42	89.4	0.9588
February . . . . .	22	80	4	5.0	80	16	20.0	40	32	80.0	0.7100
March . . . . .	26	94	0	0.0	94	0	0.0	47	16	34.0	0.0340
Total . . . . .	302	1088	19	.....	1088	115	.....	544	262	.....	.....
Average . . . . .	.....	.....	.....	1.7	.....	.....	10.6	.....	.....	48.2	0.2966

\* No tests made on 0.01 c.c. but assumed to be zero.

TABLE NO. 24. NUMBERS OF BACTERIA IN EFFLUENT WATER, 1917-1918.

MONTH	On Gelatine at 20° C.										On Agar at 37° C.						
	No. of Test Days	Mean per c.c.	Median per c.c.	Variations in Numbers: Number of Test Days						No. of Test Days	Mean per c.c.	Median per c.c.	Variations in Numbers: Number of Test Days				
				0-25	26-50	51-100	101-250	251-500	501-1,000				Above 1,000	0-10	11-25	26-30	51-100
April .....	24	150	107	0	5	6	10	2	1	0	12	10	14	7	3	0	0
May .....	25	240	300	1	3	3	5	10	3	0	15	13	10	12	4	0	0
June .....	25	95	68	1	9	7	6	2	0	0	12	10	15	8	2	0	0
July .....	24	17	15	21	3	0	0	0	0	0	18	13	6	17	0	0	1
August .....	27	19	15	20	6	1	0	0	0	0	21	16	6	17	2	2	0
September .....	24	16	12	18	6	0	0	0	0	0	10	7	17	7	0	0	0
October .....	26	85	54	9	3	6	7	1	0	0	18	9	15	6	2	3	0
November .....	25	65	60	2	7	14	2	0	0	0	5	5	25	0	0	0	0
December .....	25	70	68	1	8	13	3	0	0	0	12	8	25	0	0	0	0
January .....	25	120	110	0	2	10	13	0	0	0	38	24	13	8	3	0	0
February .....	19	710	450	0	0	0	7	4	3	5	35	21	8	3	1	10	0
March .....	25	550	278	0	0	7	5	6	3	4	35	25	0	14	9	2	1
Total .....	294			73	52	67	58	25	10	9			156	99	26	17	2
Average .....		180	128								16	12					
Per cent times .....				24.4	17.7	22.5	19.7	8.5	3.4	3.3			52.0	33.0	8.6	5.7	0.7

TABLE No. 25. BACILLUS COLI IN EFFLUENT WATER, 1917-1918.

MONTH	Bacillus Coli*										B. Coli Index No. per c.c.
	No. of Test Days	1 c.c.			10 c.c.			50 c.c.			
		Total No.	No. +	% +	Total No.	No. +	% +	Total No.	No. +	% +	
April .....	24	88	0	0.0	44	0	0.0	44	7	15.9	0.0032
May .....	26	96	1	1.0	48	4	8.3	48	18	37.5	0.0231
June .....	25	90	0	0.0	45	2	4.4	45	7	15.6	0.0055
July .....	26	92	0	0.0	46	7	15.2	46	13	28.3	0.0178
August .....	27	100	1	1.0	50	7	14.0	50	20	40.0	0.0282
September .....	24	96	0	0.0	43	3	7.0	43	8	18.6	0.0093
October .....	26	94	5	5.3	47	15	31.9	47	31	66.0	0.0917
November .....	25	88	3	3.4	44	8	18.2	44	29	65.9	0.0583
December .....	25	86	3	3.5	43	15	17.4	43	30	69.7	0.0394
January .....	26	94	10	10.6	47	29	61.7	47	45	95.7	0.1639
February .....	22	80	3	3.7	40	21	52.5	40	32	80.0	0.1113
March .....	26	94	0	0.0	47	9	19.1	47	32	66.8	0.0286
Total .....	302	1098	26	.....	544	120	.....	.....	.....	.....	.....
Average .....	.....	.....	.....	2.4	.....	.....	22.1	.....	.....	50.0	0.0493

\* No tests made on 0.1 c.c. but assumed to be zero.

TABLE No. 26. NUMBERS OF BACTERIA IN WATER DELIVERED TO MAINS, 1917-1918.

On Gelatine at 20° C.										On Agar at 37° C.									
No. of Test Days	Mean per c.c.	Median per c.c.	Variations in Numbers: Number of Test Days						N. of Test Days	Mean per c.c.	Median per c.c.	Variations in Numbers: Number of Test Days							
			0-25	26-50	51-100	101-250	251-500	501-1000				Above 1000	0-10	11-25	26-50	51-100	101-250	251-500	Above 500
April.....	530	232	0	4	5	4	4	5	24	13	11	11	12	1	0	0	0	0	
May.....	105	109	0	0	0	0	0	0	26	10	9	19	7	0	0	0	0	0	
June.....	25	25	14	10	1	0	0	0	25	8	8	20	5	0	0	0	0	0	
July.....	25	12	23	2	0	0	0	0	25	13	9	15	7	3	0	0	0	0	
August.....	27	18	14	22	5	0	0	0	26	16	15	5	20	0	1	0	0	0	
September.....	24	19	16	20	3	1	0	0	24	15	13	3	20	1	0	0	0	0	
October.....	26	14	13	24	2	0	0	0	26	9	7	20	6	0	0	0	0	0	
November.....	25	26	14	10	1	0	0	0	25	6	6	24	1	0	0	0	0	0	
December.....	25	40	17	4	2	2	1	0	25	6	5	24	1	0	0	0	0	0	
January.....	50	33	10	4	9	1	1	0	26	5	4	25	1	0	0	0	0	0	
February.....	22	110	75	4	5	3	8	0	22	14	10	11	7	4	0	0	0	0	
March.....	26	90	89	1	3	17	5	0	26	24	21	1	15	9	1	0	0	0	
Total.....	299	.....	148	52	50	34	8	2	300	.....	.....	178	102	18	2	0	0	0	
Average.....	87	55	.....	.....	.....	.....	.....	.....	.....	11	10	.....	.....	.....	.....	.....	.....	.....	
Per cent times	.....	.....	49.5	17.4	16.7	11.4	2.7	0.7	.....	.....	.....	59.3	34.0	6.0	0.7	0	0	0	

TABLE No. 27. BACILLUS COLI IN WATER DELIVERED TO MAINS, 1917-1918.

MONTH	Bacillus Coli*										B. Coli Index No. per c.c.
	No. of Test Days	1 c.c.			10 c.c.			50 c.c.			
		Total No.	No. +	% +	Total No.	No. +	% +	Total No.	No. +	% +	
April . . . . .	24	176	0	0.0	88	3	3.4	48	4	8.3	0.0044
May . . . . .	26	192	0	0.0	96	5	6.2	48	9	17.3	0.0084
June . . . . .	25	180	0	0.0	90	1	1.1	50	7	14.0	0.0037
July . . . . .	26	184	1	0.5	92	2	2.2	52	8	15.4	0.0093
August . . . . .	27	200	0	0.0	100	1	1.0	54	8	16.0	0.0038
September . . . . .	24	172	0	0.0	86	8	9.3	48	13	27.1	0.0119
October . . . . .	26	188	0	0.0	94	1	1.1	52	8	15.4	0.0039
November . . . . .	25	184	0	0.0	92	0	0.0	50	2	4.0	0.0008
December . . . . .	23	172	0	0.0	86	3	0.0	50	7	14.0	0.0056
January . . . . .	26	188	1	0.5	94	16	17.0	52	22	42.3	0.0265
February . . . . .	22	160	3	1.9	80	8	10.0	40	16	40.0	0.0331
March . . . . .	26	188	0	0.0	94	1	1.1	52	6	11.5	0.0032
Total . . . . .	302	2184	5	0.2	1092	49	4.5	596	110	18.5	0.0091
Average . . . . .											

\* No tests made on 0.1 c.c. but assumed to be zero

TABLE No. 28. BACTERIA IN WATER DELIVERED TO CONSUMERS, 1917-1918.

MONTH	Number of Bacteria on Agar at 37° C.							Bacillus Coli.*									
	No. of Test Days	Mean per c.c.	Median per c.c.	Variations in Numbers: Number of Test Days					No. Test Days	1 c.c.			10 c.c.			B. Coli Index Number per c.c.	
				0-10	11-25	26-50	51-100	101-250		Above 250	Total No.	No. +	Per Cent +	Total No.	No. +		Per Cent +
April.....	24	9	8	17	7	0	0	0	0	24	336	0	0.0	168	3	1.8	0.0018
May.....	26	10	9	19	5	2	0	0	0	26	408	7	1.7	204	16	7.8	0.0231
June.....	25	11	12	10	12	3	0	0	0	25	350	3	0.9	175	28	16.0	0.0258
July.....	25	12	11	11	12	2	0	0	0	25	350	3	0.9	175	22	12.6	0.0207
August.....	26	16	16	4	21	1	0	0	0	26	364	2	0.5	182	14	7.7	0.0122
September.....	24	14	15	5	16	2	0	1	0	24	336	4	1.2	168	33	19.6	0.0304
October.....	26	10	7	4	17	5	0	0	0	26	416	2	0.5	208	16	7.7	0.0122
November.....	25	5	4	24	1	0	0	0	0	25	400	0	0.0	200	4	2.0	0.0020
December.....	25	4	4	25	0	0	0	0	0	25	400	0	0.0	200	4	2.0	0.0020
January.....	26	4	3	25	1	0	0	0	0	26	416	0	0.0	208	15	7.2	0.0072
February.....	22	10	4	16	3	3	0	0	0	22	343	0	0.0	171	12	7.0	0.0070
March.....	26	19	16	1	18	7	0	0	0	26	416	0	0.0	208	2	1.0	0.0010
Total.....	300	.....	.....	161	113	25	0	1	0	300	4535	22	.....	2267	169	.....	.....
Average.....	.....	10	9	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.5	.....	.....	7.4	0.0119
Per cent times.....	.....	.....	.....	53.7	37.7	8.3	0	0.3	0	.....	.....	.....	.....	.....	.....	.....	.....

\*No tests made on 0.1 c.c. but assumed to be zero.

TABLE No. 29. QUANTITIES OF CHEMICALS APPLIED, 1917-1918.

	LIME			SULPHATE OF IRON			SULPHATE OF ALUMINA			CHLORINE		
	Grains per Gallon			Grains per Gallon			Grains per Gallon			Pounds per Million Gallons		
	Maximum	Minimum	Average	Maximum	Minimum	Average	Maximum	Minimum	Average	Maximum	Minimum	Average
April .....	6.00	4.25	5.29	2.13	1.13	1.44	1.00	0.50	0.56	1.75	1.50	1.64
May .....	7.50	4.75	5.62	1.25	1.00	0.92	1.05	0.63	0.76	2.50	1.50	2.50
June .....	7.50	5.00	6.41	2.00	1.00	0.83	1.12	0.99	0.97	4.50	2.00	2.99
July .....	7.13	5.63	6.84	1.75	0.75	1.01	1.03	0.69	0.73	4.00	1.50	2.66
August .....	5.63	4.63	5.48	0.88	0.25	0.45	0.92	0.57	0.58	4.00	1.50	2.85
September .....	5.50	5.00	5.46	0.38	0.13	0.16	0.56	0.11	0.36	2.00	0.00	1.04
October .....	5.88	5.00	5.55	0.38	0.06	0.14	0.66	0.22	0.35	2.50	1.50	2.03
November .....	5.50	4.25	5.23	0.38	0.26	0.23	2.69	0.64	0.67	2.00	1.50	1.58
December .....	4.75	4.50	4.98	0.25	0.00	0.14	0.92	0.58	0.67	2.00	0.00	1.60
January .....	7.25	4.00	4.79	0.50	0.00	0.10	0.88	0.66	0.67	2.00	0.00	1.43
February .....	8.00	5.00	6.35	2.50	0.00	0.61	3.68	0.81	1.10	2.50	1.50	1.76
March .....	5.00	4.50	4.99	1.50	1.00	1.14	2.58	0.43	0.74	1.40	1.40	1.40
Average .....	.....	.....	5.64	.....	.....	0.62	.....	.....	0.68	.....	.....	1.92

TABLE No. 30.

## DEPARTMENT OF PUBLIC UTILITIES—WATER DIVISION.

## OPERATION RECORD FOR YEAR ENDING MARCH 31, 1918.

### Chain of Rocks Filters.

		Basins out of Service	Days out of Service	BASINS CLEANED
Water Pumped (Chain of Rocks) in million gallons.	39317.50			
Water Consumed, in million gallons.	38089.92	No. 1 and No. 2	24	No. 1, July, May, Nov. 105,600 cu.yd.
Water Filtered.	39373.44	No. 5	11	No. 2 July 25,600 cu.yd.
Water used in Filter House Operation.	614.38	No. 6 No. 8	14 123	No. 6 Nov. 37,200 cu.yd. No. 9 August 23,200 cu.yd.
Water used in Coagulant House Operation.	95.52	No. 9	9	Baden, April and July 300 cu.yd.
Water used in Basin Operation (Filtered).	279.74	Nos. 1 and 2B.P. No. 3, B. P.	140 3	No. 1, B.P., May, Oct. 500 cu.yd. No. 2, B.P., May, July, Oct. 750 cu.yd.
Water used in Basin Operation (Unfiltered).	590.04	No. 4, B. P. Baden	46 30	No. 3, 4, B. P. May 500 cu.yd. C.H.S. Basin, Oct. 326 cu.yd.
Water used in Purification, Total.	1579.68	Compton H.S.B. Compton H.N.B.	7 7	

### Chemicals Used.

DESCRIPTION	Pounds	Grains per Gallon		
		Maximum	Minimum	Average
Lime.....	31,656,000	8.00	4.00	5.6360
Sulphate of Iron.....	3,500,000	2.50	0.00	0.6231
Sulphate of Alumina (Meters).....	3,731,644	3.68	0.11	0.6634
Sulphate of Alumina (Influent).....	2,280	0.25	0.00	0.0004
Sulphate of Alumina (Filters).....	111,035	14 lbs.	0 lbs.	0.0197 Gr.
Chlorine.....	76,352	per wash	per wash	per Gal.
		4.5 lbs.	0 lbs.	1.92 lbs.
		per M. G.	per M. G.	per M. G.

### Variations in Water.

[illegible]

**TABLE No. 31.**  
**DEPARTMENT OF PUBLIC UTILITIES—WATER DIVISION.**  
**COST RECORD FOR YEAR OF 1917-1918.**

Chain of Rocks Filters	
Coagulant House	Filter Plant.
Labor, operating..... \$ 8,162.87	Labor, operating..... \$22,078.64
Labor, unloading Lime and Iron..... 3,272.30	Labor, unloading Chemicals..... 374.41
Maintenance..... 6,545.92	Maintenance..... 4,847.63
Repairs..... 820.39	Repairs..... 2,103.90
Water..... 478.57	Water..... 6,280.66
Light..... 650.54	Light..... 1,858.42
Power..... 3,029.57	Power..... 6,133.85
Miscellaneous repairs..... 715.57	Coal..... 3,997.25
Miscellaneous supplies..... 610.93	Miscellaneous repairs..... 1,511.39
Miscellaneous expenses..... 27.56	Miscellaneous supplies..... 1,812.76
Total..... \$24,314.22	Total..... \$51,096.61
Additions and extensions.....	Additions and extensions..... \$717.63
Chemical Laboratory.	Settling Basins.
Labor..... \$10,966.25	Labor, cleaning..... \$2,240.12
Material and supplies..... 645.90	Material, cleaning..... 241.22
Miscellaneous repairs..... 1,034.31	Water, cleaning and flushing..... 3,839.46
Miscellaneous expenses..... 229.46	Repairs..... 847.77
Total..... \$12,875.92	Total..... \$7,168.57
Additions and extensions.....	Additions and extensions..... \$1,647.46
Chemicals, etc., Used.	Summary of Costs.
Lime..... \$107,109.90	Chemical Laboratory..... \$12,875.92
Sulphate of Iron..... 21,004.38	Coagulant House..... 24,314.22
Sulphate of Alumina..... 42,788.85	Filter Plant..... 51,096.91
Chlorine..... 10,212.09	Basins..... 7,186.57
Switching..... 6,171.75	Chemicals..... 187,346.99
Demurrage..... 60.00	Total..... \$282,802.61
Total..... \$187,346.99	Additions, etc..... \$2,386.09
Pumping in M. G..... 39,317	Purification cost per M. G. pumped..... 7.19
Consumption in M. G..... 38,090	Purification cost per M. G. consumed..... 7.43

## SUPPLY AND PURIFYING SECTION.

### REPORT OF FILTER PLANT OPERATION.

St. Louis, Mo., June 1st, 1918.

MR. A. V. GRAF,  
Chemist.

DEAR SIR: During the year 38,612 million gallons of water were filtered at a cost of \$2.74 per million gallons. The amount filtered does not include the water used for washing filters, dissolving aluminum sulphate, etc. The cost per million gallons includes the cost of operation, maintenance, repairs, light and power, coal and the chemicals used in the applied and filtered water.

The forty filters were continually in service except for short periods when minor repairs were being made. The rate of filtration during the year varied from a maximum of 143.1 million gallons per acre per day to a minimum of 31.1, averaging 85.2 million gallons per acre per day. The maximum run of a filter was 206.75 hours filtering 22.63 million gallons, the minimum run was 7.67 hours filtering 1.24 million gallons and the average run was 50.23 hours filtering 5.66 million gallons.

During the year 8,964 filters were washed, using 614.38 million gallons of water or 1.57 per cent of the water filtered.

In November a mechanical analysis was made of the sand in each filter unit. The results of this analysis are shown in Table No. 32, together with similar analyses made in the two previous years.

In December, 1916, and again in December, 1917, the depth of the sand beds in each filter were measured. Ten of the forty filters showed an average depth increase of  $\frac{1}{4}$ " of sand, three of them showed no change in depth and the remaining twenty-seven filters showed a loss of  $\frac{3}{4}$ " of sand.

The rate of wash during the year has been kept fairly constant, about fifteen gallons per square foot per minute. With this rate of wash the mud balls do not accumulate, but with a lower rate the increase in number and size is quite noticeable. Once every month each filter is washed at a rate of seventeen gallons per square foot. At this time a  $\frac{1}{4}$ " screen is pulled through one section in each half of the filter unit.

The number of mud balls caught on the screen are counted; if there is an increase over the previous month the rate of wash is increased until the mud balls are again normal. In this way a good check is kept on the condition of the sand bed.

In February, 1917, and again in January, 1918, loss of head measurements were made on each filter while washing at a rate of 20,000 gallons per minute.

A considerable amount of sand was found on top of the strainer plates, varying from  $\frac{1}{4}$ " to 1" in depth; some of the lateral channels were completely filled with sand. The depth of sand under the plates varied from 3" at the east and west ends of the filter to nothing toward the center.

Part of the effluent pipe was removed and an examination of the interior of the under-drains were made. Sand was found in the 10" pipe connecting the outlet castings in the filter bottom. Concrete and rubbish were found in the four 10" elbows in the under-drain system which reduced the area from 30 to 50 per cent. This material was removed by drilling  $1\frac{1}{2}$ " holes in the under-drains and loosening the material with a chisel and flushing with a hose.

Two cracked center plates and about twelve broken U-bolts were found and some of the end plates were not properly grouted, particularly the end of the plate near the wall, leaving sufficient room for sand to get by. A large number of holes in all of the plates were found stopped up with sand and underneath all of the plates there was a soft greenish scale forming, which is now about  $\frac{1}{32}$ " thick in places. This scale reduced the area of a large number of holes. An analysis of the scale gave the following results:

Loss on ignition.....	10.6 per cent
ZnO .....	38.7 per cent
SiO <sub>2</sub> .....	2.9 per cent
CuO .....	41.0 per cent
Al <sub>2</sub> O <sub>3</sub> .....	3.0 per cent
Ca and Mg.....	trace
Pb SO <sub>4</sub> .....	2.2 per cent

All of the sand in the lateral channels was flushed to the central channel with a hose and removed with scoops. The center plates were replaced and the end plates grouted where necessary. After cleaning all of the holes in the plates and replacing the gravel and sand, the filter was put in operation. The loss of head in washing was reduced from 16 feet to 7.8 by the overhauling.

On July 25th, it was found that a stick could be shoved through the filtering material to a bare strainer plate in the north half of Filter No. 2 while washing. On examination it was found that several end strainer plates were loose which had caused the gravel in three places to be washed out in heaps. The loose plates were fastened and regouted.

On February 11th, 1918, after draining down Filter No. 25, preparatory to washing, a large hole was observed in the sand bed on the north half of the filter. Upon exposing the strainer plates it was found that one U-bolt had broken in an end plate, causing the plate to be slightly bent up. This break probably occurred on the previous wash. Several cubic feet of sand were found in some of the lateral channels at and near the break as well as some sand in the under-drain pipe. This sand was removed as in Filter No. 23. Debris, concrete, etc., was likewise removed from several elbows.

U-bolts are probably broken by admitting the wash water too rapidly at the beginning of the wash. Every U-bolt that has thus far broken was found to be a defective one, half of the section showing an old break. The break always occurs at the bottom of the U. In going over our stock of U-bolts it was found that about 25 per cent could be broken very easily by merely pulling apart with the hands.

The total amount of air entrained during a single run of each of eight filters was measured once during each month from July to January. The results are recorded in Table No. 33. The measurements were made as follows: The filter was drained preparatory to washing to within a few inches of the top of the sand. The effluent valve was shut and quick measurements taken to compute the apparent amount of water required to fill the filter to the overflow of the lateral gutters. Wash water was then very slowly admitted until the water was about to overflow in the gutters. During this interval all of the entrained air was liberated. The actual amount of water admitted was measured in the wash water tank. The difference between the actual amount and the computed gave the volume of entrained air at less than atmospheric pressure. The water temperature was taken at each measurement.

In October and November, 1917, a test was made on each of the forty filters to determine the accuracy of the rate controllers while filtering at various rates. The results show that the average indicated rate is about  $1\frac{1}{2}$  per cent higher than the actual rate.

During the year 1922.48 tons of aluminum sulphate have been used. The average cost of unloading is \$0.203 per ton.

The aluminum sulphate is added to the water in solution form, the strength of solution depending on the charge. The charge has varied during the year from a minimum of 0.11 grains per gallon to a maximum of 3.68 grains per gallon, the average being 0.6634 grains per gallon of water filtered. The solution strength has varied from 1 per cent to 3 per cent. The solution is kept as weak as possible to prevent unnecessary corrosion of the metal parts with which it comes in contact.

The concrete dissolving boxes were thoroughly overhauled during the year. The concrete surface was chipped, resurfaced with sand and cement, painted with a heavy coat of pitch and then two coats of asphalt paint were applied. The outlet piping from the dissolving boxes and all elbows and tees placed horizontally have been renewed.

The waterproofing on the bottom of the solution tanks has been worn off, but on the side walls it is still intact. The exposed concrete surface at the bottom is in fair shape, only the finish being raveled.

The agitator shafts in the chemical solution tanks are constantly exposed to the action of the sulphate solution. A new shaft was put in No. 3 tank last June, and it is probable that those in the remaining tanks will need replacing during the coming year.

All of the 3" gate valves (twelve in number) around the chemical solution pumps leaked badly. They were repaired by casting new gates and scraping the seat in the body of the old valve. The repairs were made in September and no trouble has been experienced since.

All of the 3" bronze piping around the chemical pumps has been taken apart during the year and the interior scraped and painted with asphalt. The scale in the pipe was very hard and about  $\frac{1}{8}$ " thick. Aside from this scale the interior of the pipe is in very good condition, the hard scale protecting the metal from corrosion.

In November a new set of impellers and labyrinth rings were put in each of the two chemical pumps, the old parts being corroded to such an extent that it was becoming impossible to pump enough solution to supply the demand.

The sulphate solution is pumped through two 4" lead lines to a receiving trough at the north end of the Filter Plant. The excess is returned to the pumps through a single 4" lead line. The west discharge line is connected up by  $1\frac{1}{4}$ " lead pipe to the influent pipe at each filter. Several times during the year these pipes have had to be cleaned of the deposit that settles out from the sulphate solution.

The greater part of the soft deposit is flushed out, but there is a rather hard scale that forms in the pipe that must be scraped out with a disc. An analysis of the hard scale follows:

Loss on ignition.....	{	SO <sub>3</sub>	15.0 per cent
	{	H <sub>2</sub> O	13.9 per cent
SiO <sub>2</sub> .....			6.4 per cent
Fe <sub>2</sub> O <sub>3</sub> .....			57.9 per cent
Al <sub>2</sub> O <sub>3</sub> .....			6.4 per cent
PbO .....			0.3 per cent
Ca and Mg.....			trace

Except for a period of twenty days during the month of February, the equivalent of fourteen pounds of sulphate in solution form was added to each filter after washing.

The bronze outlet casting in the orifice boxes of the automatic chemical meters and the conical plugs that regulate the area of the outlet, have been corroded by the sulphate solution to such an extent that the automatic control does not properly change the amount of solution to be fed in proportion to the amount of water passing the 8-foot meters. Regulation must frequently be made by hand. These parts will be replaced in a short time.

### CHLORINE.

During the year 76,352 pounds of chlorine have been added to the filtered water, the maximum charge being 4.50 pounds per million gallons, the minimum 0 and the average 1.92 pounds per million gallons of water filtered.

Three of the old float type chlorine meters have been replaced by three new orifice meters, the first one being installed June 29th, the next November 2d and the last December 6th. These machines were purchased from the Electro Bleaching Gas Co.

At first carbon tetrachloride was used in the manometer tube, but on account of its volatility, sulphuric acid was substituted. No trouble has been experienced with the acid, but care in operation is required to prevent the acid from getting into the metal parts of the machine.

Blank scales and silver discs for making orifices were furnished by the company. In two of the discs 5/32" holes were drilled, in the other 1/8" hole; a scale was calibrated for each machine.

Repeated checks show the calibrations to be correct within about 3 per cent.

When feeding chlorine at the rate of about six pounds per hour or more through any of the machines, trouble was frequently experienced from gas leaking over the top of the absorption tower. If enough water was used to absorb this gas, it overflowed the tower. It seemed probable that the discharge line (a 2-inch brewery hose), which carried the chlorinated water from the manifold of the absorption towers to the point of application (a distance of about 150 feet) was too small.

With the idea of relieving this congestion, a new 4-inch clay pipe line was laid. The pipe used was the standard 4-inch vitrified clay pipe in 2-foot sections. The joints were made with litharge and glycerine, clay and cement. All poorly glazed pipes were coated with litharge and glycerine. After being laid the entire line was coated several times with asphalt paint.

Upon testing the line, slight leaks developed at various joints and in the body of the pipe itself, particularly along that part of the line which is exposed in the drawing conduit chamber. About 20 feet of the exposed line over the drawing conduit chamber was replaced with 1½-inch hard rubber pipe. To date only a slight leak has developed where the hard rubber pipe joins the tile. It is expected that the coating which forms in the pipe will eventually stop all leaks.

The Draeger oxygen apparatus purchased during the early part of the year has been used several times for protecting the men from chlorine gas and ammonia during leaks in the chlorine apparatus or at the ice machine.

Last fall the fronts on all of the boilers in the boiler room were repaired. The brick lining in all of the boilers at the water grates was removed and repaired. An entire new set of grate bars was put in No. 2 boiler. Before next winter it will probably be necessary to replace the grate bars in Boilers Nos. 1 and 3.

On January 12th, with an outside temperature of 17° below zero, the water in the pipes connecting the float tubes with the 8-foot concrete Venturi meters froze underneath the flow plates outside the north-west corner of the Filter Plant. They were thawed out with a blow torch and protected by constructing a wooden box, packed with sawdust, around them.

All of the columns in the Filter Plant and the walls of the sulphate dissolving and pump rooms have been given a wash of cement.

During the past summer it has been necessary to frequently change the rate of filtration. This was true from the time of the break in the conduit between Baden to Bissell's Point, which occurred on May 14th.

until it was finally repaired in October. The maximum elevation at which the basins at Bissell's Point could be carried was limited on account of the danger of overflow at the break. In addition to this, when only two basins at Bissell's Point were in service, starting or stopping a pump at irregular intervals would cause the elevation to change considerably in a short time.

The greatest amount of water filtered during a single day occurred January 15th, when 167.1 million gallons passed through the filters. The average rate of that day for each of thirty-nine filters was 4.6 million gallons.

The average static head under which the filters operated when filtering at the rate of 94.6 million gallons was 10.2 feet, thus causing the rate to fall off when the loss of head reached 8 or 9 feet.

The six gatemen, who formerly operated the gates on the settling basins and were used for odd jobs in the Filter Plant when first started, have resigned or been promoted and their positions left vacant, as their services were no longer necessary.

The operating log of the plant for the fiscal year is shown in Table No. 34.

Respectfully,

AUGUST G. NOLTE.

Superintendent, Filter Plant.

TABLE No. 32. MECHANICAL ANALYSES OF FILTER SAND.

Filter Number	October and November, 1915				January, 1916, and December, 1917				November and December, 1917			
	Effective Size 10% Finer than in mm.	60% Finer than in mm.	Uniformity Co-efficient	Number of Washings for August to November Inclusive	Effective Size 10% Finer than in mm.	60% Finer than in mm.	Uniformity Co-efficient	Number of Washings for October to January Inclusive	Effective Size 10% Finer than in mm.	60% Finer than in mm.	Uniformity Co-efficient	Number of Washings for September to December Inclusive
1.....	.313	.540	1.72	154	.390	.660	1.69	65	.370	.52	1.41	81
2.....	.320	.590	1.84	135	.370	.580	1.37	68	.360	.54	1.50	86
3.....	.308	.590	1.92	128	.390	.730	1.87	65	.383	.58	1.51	83
4.....	.305	.530	1.74	153	.382	.650	1.70	68	.360	.50	1.39	86
5.....	.300	.550	1.83	128	.380	.610	1.60	69	.358	.56	1.56	90
6.....	.350	.580	1.65	155	.375	.580	1.55	70	.350	.54	1.54	88
7.....	.325	.610	1.87	195	.380	.660	1.74	62	.389	.56	1.44	82
8.....	.298	.560	1.88	137	.386	.620	1.62	63	.377	.61	1.09	84
9.....	.310	.575	1.86	115	.384	.580	1.51	64	.378	.58	1.53	78
10.....	.330	.700	2.06	143	.415	.610	1.58	65	.464	.72	1.55	83
11.....	.340	.620	1.88	114	.415	.720	1.74	55	.407	.63	1.55	67
12.....	.316	.580	1.83	152	.390	.680	1.74	62	.390	.59	1.51	85
13.....	.350	.630	1.80	117	.387	.530	1.74	60	.392	.54	1.38	76
14.....	.340	.620	1.82	126	.380	.530	1.40	65	.410	.58	1.41	81
15.....	.340	.630	1.85	138	.400	.620	1.55	64	.410	.60	1.46	81
16.....	.320	.600	1.87	138	.345	.545	1.58	66	.398	.63	1.58	92
17.....	.323	.630	1.95	131	.400	.710	1.77	69	.390	.57	1.46	78
18.....	.322	.590	1.83	128	.370	.570	1.54	61	.370	.58	1.57	78
19.....	.345	.630	1.82	121	.400	.680	1.70	62	.420	.62	1.48	73
20.....	.350	.610	1.74	112	.395	.700	1.77	58	.398	.62	1.56	73
21.....	.460	.760	1.65	83	.465	.770	1.66	44	.445	.65	1.46	56
22.....	.350	.650	1.86	134	.405	.670	1.65	57	.390	.57	1.41	71
23.....	.380	.580	1.81	111	.450	.710	1.58	45	.600	.82	1.37	74
24.....	.380	.600	1.58	91	.420	.660	1.57	44	.440	.58	1.32	57
25.....	.420	.640	1.52	80	.490	.730	1.49	43	.490	.67	1.37	73
26.....	.330	.690	2.09	109	.456	.700	1.60	41	.480	.65	1.35	58
27.....	.310	.570	1.84	117	.400	.700	1.75	58	.400	.63	1.56	74
28.....	.320	.540	1.69	120	.384	.580	1.71	66	.388	.54	1.39	78
29.....	.320	.570	1.78	125	.380	.625	1.64	63	.381	.56	1.47	84
30.....	.340	.600	1.76	126	.380	.570	1.50	60	.382	.60	1.57	74
31.....	.320	.590	1.84	133	.370	.620	1.68	65	.370	.57	1.54	85
32.....	.328	.570	1.74	127	.390	.610	1.55	63	.375	.55	1.46	85
33.....	.320	.620	1.94	128	.373	.540	1.45	62	.365	.52	1.41	92
34.....	.392	.725	1.81	105	.420	.680	1.62	47	.470	.69	1.46	54
35.....	.390	.680	1.84	96	.445	.670	1.51	41	.454	.61	1.33	61
36.....	.390	.725	1.74	88	.400	.595	1.49	41	.465	.65	1.39	54
37.....	.330	.630	1.91	109	.390	.620	1.59	58	.387	.54	1.39	77
38.....	.405	.710	1.75	83	.400	.730	1.82	44	.440	.58	1.30	50
39.....	.346	.630	1.82	123	.375	.550	1.47	55	.378	.57	1.37	87
40.....	.346	.610	1.76	111	.390	.700	1.79	51	.380	.54	1.42	75
Average.	.341	.611	1.82	.....	.397	.643	1.61	.....	.407	.60	1.45	.....

TABLE No. 33. AIR ENTRAINED IN FILTER BEDS PER MILLION GALLONS OF WATER FILTERED.

Filter No. 4		Filter No. 13		Filter No. 18		Filter No. 19		Filter No. 22		Filter No. 24		Filter No. 36		Filter No. 37		Av. of 8 Filters	
A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
0.7	7.9	0.7	6.2	0.7	6.3	0.8	3.6	1.0	7.1	1.0	5.1	0.7	4.8	1.0	14.0	0.8	6.87
8.0	4.9	8.0	2.64	8.0	4.3	7.0	1.54	8.0	3.5	8.0	1.98	5.5	1.56	8.0	2.85	7.6	2.90
11.5	1.38	12.5	1.45	12.0	1.82	12.0	0.78	13.0	.66	13.0	.56	12.0	.48	13.5	1.16	12.4	1.06
22	1.66	22.2	1.19	22.0	1.11	22.0	0.61	22.0	.95	20.0	.51	20.0	.34	22.0	.78	21.5	.80
26.0	.60	26.5	.73	26.0	.43	26.0	.57	25.5	.52	25.5	.47	26.5	.24	27.0	.38	26.4	.51
27.5	.47	26.5	.35	27.0	.45	27.0	.41	26.0	.86	26.5	.65	26.5	.55	26.0	.46	.....	.....

A = Temperature of water—Degree Centigrade.

B = Cu. ft. of air per M. G. of water filtered per hour.

TABLE No. 34. RECORD OF FILTER OPERATION, APRIL, 1917, TO APRIL, 1918.

	April	May	June	July	August	September	October	November
Water Filtered in M. G.	2,890.8	3,075.9	3,276.28	3,785.31	3,635.18	3,164.18	3,071.62	2,838.12
Number of Filters in Operation	38.	40.	40.	40.	40.	40.	40.	40.
Number of Filtering Hours	27,294	29,654	28,718	29,612	29,677	28,730	29,668	28,602
Rate per day in M. G. per filter.	Max. 3.5	3.4	4.0	4.0	4.0	3.2	3.30	3.0
	Min. 1.7	1.5	2.0	2.5	1.0	2.2	1.00	2.0
	Av. 2.54	2.49	2.74	3.07	2.94	2.64	2.48	2.38
Average rate filtered M. G. D. per acre	79.02	77.46	85.24	95.51	91.46	82.13	77.15	74.04
Number of Washings	450	563	461	426	418	351	394	750
Amount Filtered per wash in M. G.	Max. 13.02	10.47	14.75	15.4	17.72	19.63	22.63	6.76
	Min. 3.18	1.40	2.45	5.89	6.56	4.19	5.44	2.27
	Av. 6.42	5.46	7.11	8.83	7.0	9.02	7.79	3.78
Run of Filter in Hours	Max. 140.18	107.90	135.83	125.75	144.3	180.0	206.75	71.25
	Min. 29.90	12.60	21.50	48.00	48.8	38.4	49.25	21.33
	Av. 60.60	52.70	62.30	69.50	71.0	81.9	75.30	38.20
Amount of Wash Water Used in M. G.	Max. 36.45	47.85	43.07	41.20	40.54	36.86	37.54	57.40
	Min. 113.50	123.50	134.50	128.50	131.00	153.5	129.5	124.50
	Av. 65.80	64.70	70.10	62.80	74.50	87.2	74.4	55.20
Water Used per Wash in 1,000 gallons	Max. 81.00	84.99	93.43	96.72	97.00	105.0	95.3	76.54
	Av. 20,500	20,500	21,000	21,000	21,000	21,000	21,000	21,000
Rate of Wash G. P. M.	1.26	1.56	1.314	1.09	1.11	1.16	1.22	2.02
Per Cent of Filtered Water Used in Washing	22.	27.	16.	15.	19.	18.	18.	29.
Turbidity of Applied Water	Max. 9.	13.	7.	7.	7.	8.	5.	4.
	Min. 0.	0.	0.	0.	0.	0.	0.	0.
	Av. 13.	13.	9.	9.	12.	11.	11.	8.
Turbidity of Filtered Water	Max. 0.	0.	0.	0.	0.	0.	0.	0.
	Min. 0.	0.	0.	0.	0.	0.	0.	0.
	Av. 0.	0.	0.	0.	0.	0.	0.	0.
Color of Applied Water	Max. 24.	19.	16.	14.	14.	13.	11.	9.
	Min. 11.	11.	11.	10.	10.	9.	8.	5.
	Av. 14.	15.	13.	12.	12.	10.	9.	7.
Color of Filtered Water	Max. 19.	14.	12.	11.	9.	7.	6.	4.
	Min. 12.	12.	11.	10.	8.	8.	8.	6.
	Av. 0.85	1.055	1.12	1.03	0.92	0.56	0.66	2.69
Aluminum Sulphate Used in Basin, Gr. per gallon	Max. 0.50	0.633	0.99	0.69	0.57	0.11	0.22	0.64
	Min. 0.	0.746	0.956	0.715	0.574	0.353	0.342	0.647
	Av. 0.547	0.	0.	0.	0.	0.	0.	0.
Aluminum Sulphate Used in Influent Flume, Gr. per gal.	Max. 0.	0.	0.	0.	0.	0.	0.	0.
	Min. 0.	0.	0.	0.	0.	0.	0.	0.
	Av. 0.	0.	0.	0.	0.	0.	0.	0.
Sulphate Used in Filter Bed, Pounds per Wash	Max. 14.	14.	14.	14.	14.	14.	14.	14.
	Min. 116.068	166.925	226.925	196.420	151.855	82.230	77.675	136.330
	Av. 1.75	2.5	4.0	4.0	2.0	2.0	2.5	2.0
Chlorine Used, in Pounds per Million Gallons	Max. 1.50	1.5	2.0	2.0	1.5	1.5	1.5	1.58
	Min. 1.64	2.05	2.66	2.66	2.85	1.04	2.03	45.00
	Av. 47.37	63.05	97.88	100.69	103.65	32.90	62.4	156.00
Coal Used, in Tons	Max. 116.50	16.90	None	None	None	None	80.00	156.00

TABLE No. 34. RECORD OF FILTER OPERATION, APRIL, 1917, TO APRIL, 1918—Continued.

	December	January	February	March	Total for Year	Maximum	Minimum	Average
Water Filtered in M. G. ....	3,443.70	4,087.1	3,124.89	2,980.36	39,373.44			
Number of Filters in Operation.	40.	40.	39.	40.		40.	38.	
Number of Filtering Hours.	29,480.	28,810.	25,829.	29,000.	345,074.00			
Rate per day in M. G., per filter.	{Max. 4.0 Min. 2.1 Av. 2.8	{4.6 4.4 3.4	{4.0 2.9 2.9	{3.0 2.0 2.47		4.6	1.0	
Average Rate Filtered M. G. D., per acre.	87.11	105.77	90.22	76.81		143.11	31.11	2.74
Number of Washings.	1,512.1	1,529.	1,173.	937.	8,961.00			85.24
Amount Filtered per Wash in M. G.	{Max. 3.91 Min. 1.33 Av. 2.28	{4.27 1.39 2.67	{4.74 1.24 2.66	{7.67 1.45 3.18		22.63	1.24	
Run of Filter in Hours.	{Max. 40.17 Min. 10.17 Av. 19.50	{7.67 10.42 18.80	{42.25 10.42 22.00	{77.33 12.83 30.90		206.75	7.67	5.66
Amount of Wash Water Used in M. G.	{Max. 74.88 Min. 82.7 Av. 17.1	{74.15 77.0 21.0	{59.60 61.8 35.8	{64.81 95.50 42.90		153.5		50.23
Water Used per Wash in 1,000 gallons.	{Max. 82.7 Min. 17.1 Av. 49.5	{77.0 21.0 48.5	{61.8 35.8 50.8	{95.50 42.90 69.20			17.1	79.00
Rate of Wash G. P. M.	20,500.	20,500.	21,000.	21,000.		21,000.	20,500.	
Per Cent of Filtered Water Used in Washing.	2.17	1.81	1.91	2.18		35.0		1.57
Turbidity of Applied Water.	{Max. 13. Min. 4. Av. 7.	{20. 4. 12.	{35. 3. 10.	{28. 7. 13.			3.0	11.0
Turbidity of Filtered Water	{Max. 0. Min. 0. Av. 0.	{0. 0. 0.	{0. 0. 0.	{0. 0. 0.		0.0	0.0	0.0
Color of Applied Water	{Max. 8. Min. 6. Av. 7.	{12. 6. 9.	{28. 7. 13.	{26. 13. 18.		28.0	5.0	
Color of Filtered Water	{Max. 8. Min. 4. Av. 6.	{10. 5. 7.	{24. 5. 10.	{23. 10. 16.		24.0	4.0	12.0
Aluminum Sulphate Used in Basin, Gr. per gallon.	{Max. 0.92 Min. 0.58 Av. 0.637	{0.88 0.66 0.639	{3.68 0.81 1.084	{2.58 0.43 0.713		3.68	0.11	0.6634
Aluminum Sulphate Used in Influent Flume, Gr. per gal.	{Max. 0. Min. 0. Av. 0.	{0. 0. 0.	{0. 0. 0.	{0. 0. 0.		0.25	0.0	
Sulphate Used in Filter Bed, Pounds per Wash.	167,025	197,025	245,810	158,190	1,922.483			0.0004
Sulphate Used, in Tons.	{Max. 2.0 Min. 0.0 Av. 1.6	{2.0 0.0 1.43	{2.5 1.5 1.76	{1.4 1.4 41.80		4.5	0.0	14.0
Chlorine Used, in Pounds per Million Gallons.	55.23	58.57	54.98	41.80	763.52			1.92
Coal Used, in Tons.	262.50	370.015	254.45	92.40	1,348.765			

## OPERATING SECTION.

### REPORT OF CHIEF MECHANICAL ENGINEER.

St. Louis, Mo., June 1st, 1918.

MR. FRANCIS T. CUTTS,  
Assistant Water Commissioner.

DEAR SIR: I respectfully submit herewith the report of the activities and records of the Operating Section for the year ending April 1st, 1918:

Owing to the marked advance in the price of materials, supplies and labor, the total cost of pumping a million gallons of water for the year 1917-1918 was \$11.009, as compared with \$8.537 for the preceding year, 1916-1917, an increase of 29 per cent.

The coal consumption in pounds per million gallons of water pumped at the three stations for the past year compared with the preceding year is as follows:

STATION	1917-18	1916-17	
L. S. Station No. 2, Chain of Rocks.....	980	1014	3.35% gain
H. S. Stations Nos. 1 and 2, Bissell's Point.....	2026	1968	2.94% loss
H. S. Station No. 3, Baden.....	2626	2991	12.20% gain
H. S. Stations Nos. 1, 2 and 3.....	2274	2411	5.68% gain

The Bissell's Point station shows an increase in coal consumption per million gallons of water pumped, due principally to the boiler furnaces, the ignition arches being improperly shaped for burning low-grade coal. The arches are being reconstructed and consequent improvement is expected.

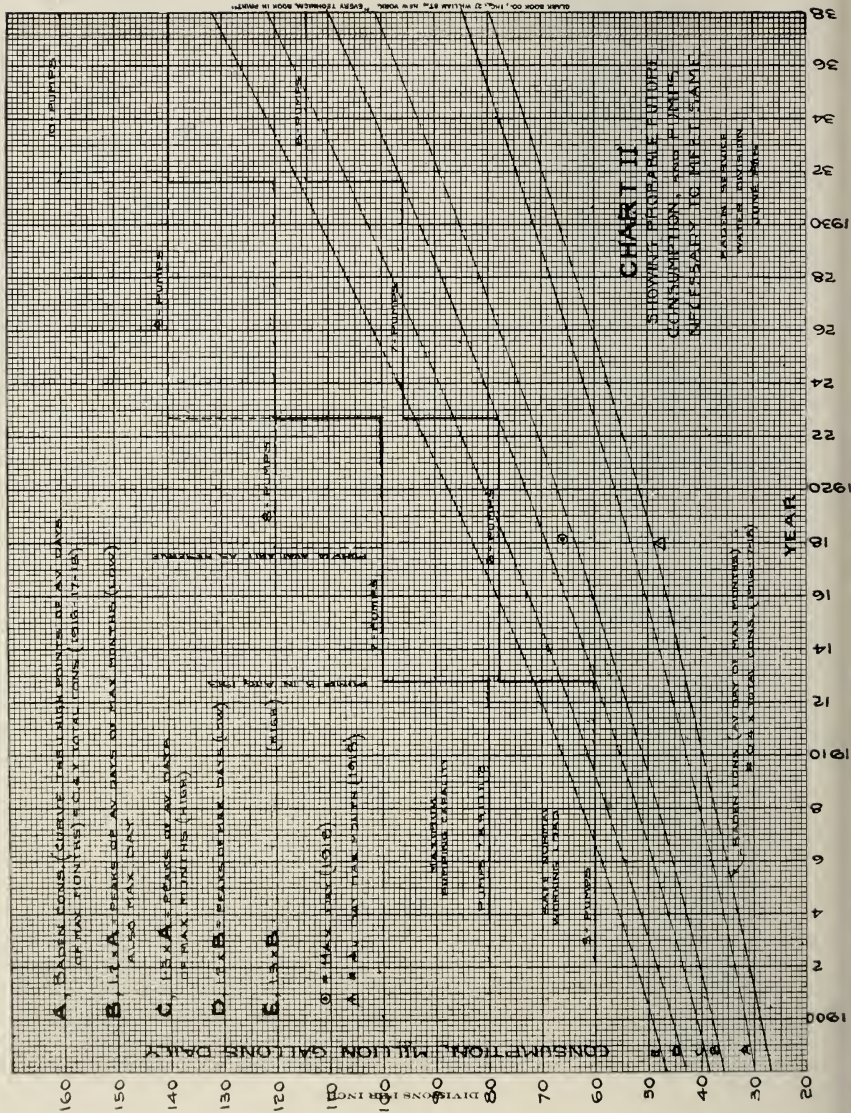
At the Chain of Rocks and the Baden stations a saving in coal consumption per million gallons of water pumped was effected as a result of close and intelligent attention to operating conditions in the boiler and engine rooms. The saving at these stations is worthy of notice, because of the handicap of the inferior grade of coal that was at the disposal of the Water Division during the past year.

The average daily high service pumping for the past year was 104.4 million gallons, as compared with 97.7 million gallons for the previous year, showing an increase of 6.7 million gallons or 6.85 per cent. The pumping capacity of each station was taxed to its limit on several occasions, particularly during the month of January, 1918. The

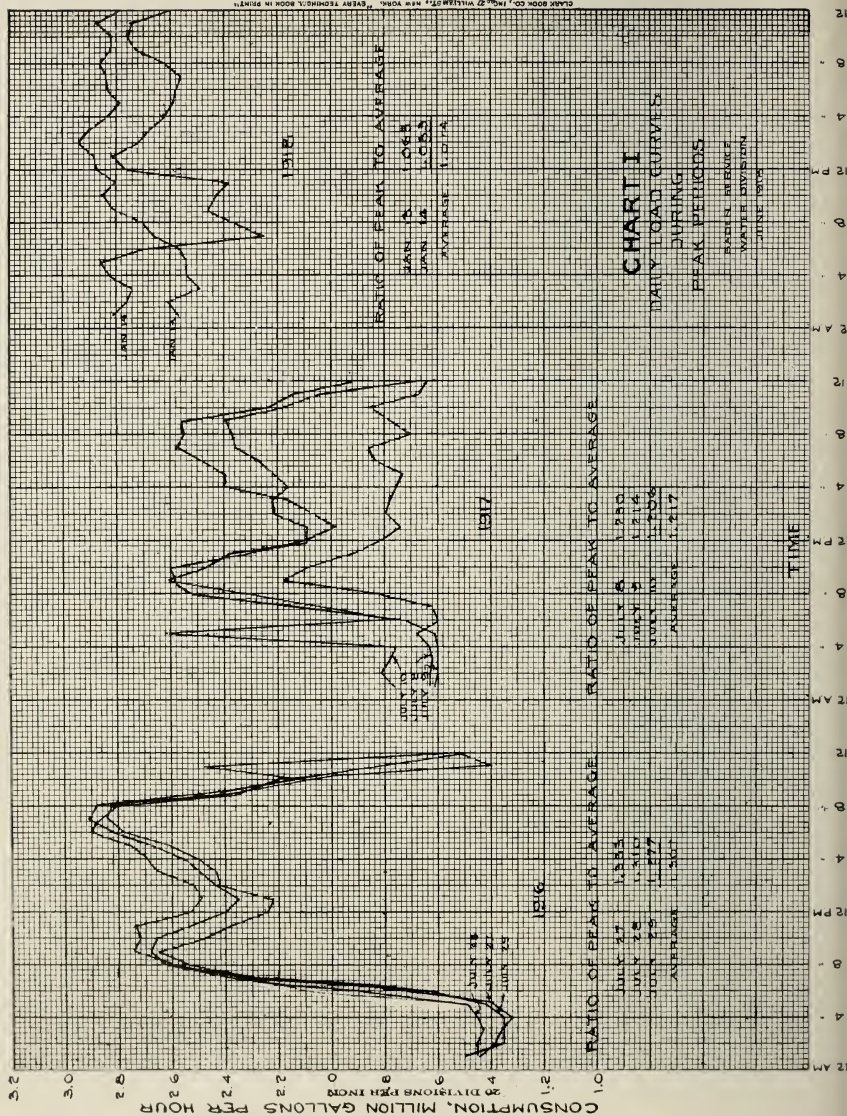
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maximum daily pumping of the high service stations was 156,475,900 gallons of water and the average daily pumping for the month of maximum demand was 116.2 million gallons.

Last year's annual report (1916-1917) referred to the report of an investigation of the pumping records for the past twenty years with a view of determining just what additions should be made to the present pumping equipment to meet the immediate needs of the City. The results of this report were based on the assumption that for the past few years the Baden and Bissell's Point services pumped approximately equal amounts of water. Due to a distribution survey having been made since, and all interconnections between the two services having been closed, this balanced condition no longer exists. Baden service supplies nearly 0.4 and Bissell's Point service 0.6 of the total consumption. Thus the common safe ratio as determined in the report referred to, no longer holds. True safe ratios should be determined on the number of pumps available for safe working conditions. The following tables are based on actual working conditions:

BADEN SERVICE	SAFE NORMAL WORKING LOADS						
	Baden Pump.....	7	8	9	10	11	12
	Speed, full r. p. h.....	1020	1020	1020	1020	1020	1020
	Speed, Normal do.....	950	950	950	950	950	950
	Capac. M. G. D. full.....	10	10	15	15	15	15
	Capac. do normal.....	9.3	9.3	14	14	14	14
Pumps 7, 8, 9, 10, 11 at normal running.....60.6 M. G. D.							
Pumps 9, 10, 11, 12 at full load running.....60 do							
Adding pump 13 at normal running, plus.....18 do							
		78		do			
BISEL'S POINT SERVICE	Point Pump.....	1	2	3	6	13	14
	Speed, full r. p. m.....	16 $\frac{3}{4}$	16 $\frac{3}{4}$	16 $\frac{3}{4}$	20	20	.....
	Speed, normal do.....	15	15	15	18	18	.....
	Capac. M. G. D. full.....	20	20	20	20	20	24
	Capac. do normal.....	18	18	18	18	18	20
Three Pumps running normal.....54 M. G. D.							
Four Pumps running normal.....72 do							
Five Pumps running normal.....90 do							

Chart 1 represents the daily load curves of the maximum days for the Baden service. From these curves the ratio of peak to average varies from 1.3 (high) to 1.2 (low) for the summer days, and 1.1 for the winter days. In Chart 2, the consumption curves are adapted from Plate 1 of the 1915 supplemental report, and the curves A, B, C, D and E are constructed from the ratios of Chart 1. Chart 3 is similar to Chart 2, except that it applies to the Bissell's Point service. From the supplemental report of 1915, page 13, the ratio of the maximum

day to the average day of the maximum month =  $\frac{150}{120} = 1.2$  and for this reason curve B on Chart 2 represents the maximum day consumption as well as the low peak demand of the average day of the maximum month.

Referring to Chart 2, whenever the safe normal pumping load drops below curve C, or whenever the total pumping capacity drops below curve E, it is necessary to provide additional pumping capacity.

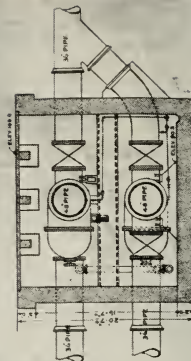
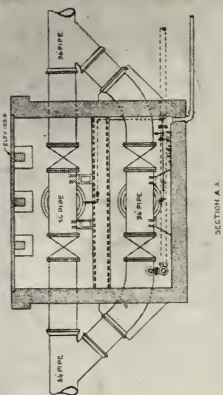
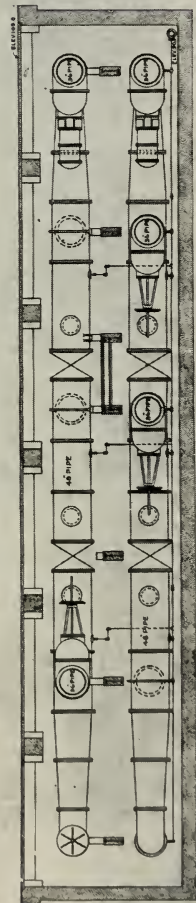
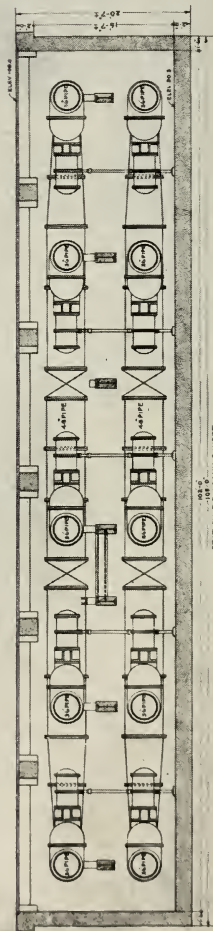
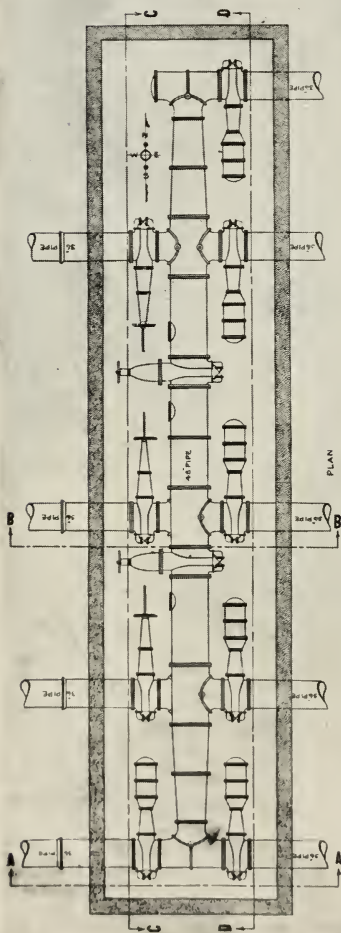
Referring to Chart 3, whenever the safe normal pumping load drops below curve A, or whenever the total pumping capacity drops below curve B, it is necessary to provide additional pumping capacity.

Chart 2 shows pump 13 as being on the Baden service, whereas actually pump 13 has been running on the Bissell's Point service since May, 1916. Five engines were necessary to meet the pumping demands on this station practically throughout the entire maximum month of the past year (see table below). During this month the Baden station varied between five and six pumps running, leaving only pump 14, and at times a Baden pump for reserve. (See table below.)

Table showing hours of service of the PUMPS AT BISSELL'S POINT During the Maximum Month.							Table showing hours of service of the PUMPS AT BADEN During the Maximum Month.						
Pump No.	1	2	3	6	13	14	Pump No.	1	8	9	10	11	12
Jan. 1...	24	24	16	24	20	.....	12½	5½	10	24	24	24	9
2...	7	21	16	24	23	.....	11½	9½	14½	24	22½	24	3
3...	21	24	3	24	24	.....	12	17	24	.....	24	10	10
4...	9	24	15	24	24	.....	14	15	24	.....	10	24	24
5...	24	24	13	24	24	.....	12½	7	19	15	24	5	5
6...	24	24	21	13	8	.....	3	8½	4½	24	24	11	11
7...	20	18	10	24	24	.....	8	9	22	11½	20	15½	24
8...	24	24	.....	24	24	.....	4½	9½	24	.....	18	24	24
9...	24	2	22	24	24	.....	6	8	24	.....	24	18	24
10...	24	.....	24	24	24	.....	7	4	24	15	5	24	24
11...	24	24	18½	24	24	.....	19½	7½	8	24	14½	13½	24
12...	24	24	24	24	24	.....	23½	.....	24	24	24	13½	24
13...	24	24	24	24	24	.....	16	11	24	24	24	24	24
14...	24	24	24	24	24	.....	.....	20	22½	24	24	24	24
15...	24	24	23	24	24	.....	.....	24	18½	24	24	24	24
16...	24	24	15½	24	24	.....	9	7½	24	20	20½	24	24
17...	18	3½	15½	18	18	.....	6½	12	20	15½	24	8½	24
18...	24	24	24	23	24	.....	12½	8	24	10	24	9	24
19...	16	24	24	23	24	.....	8	12	24	9½	9½	24	24
20...	15½	24	24	18	24	.....	11½	9	9	24	9	23½	24
21...	24	24	24	24	24	.....	16	10½	17½	10	21	14	14
22...	24	24	24	24	24	.....	10½	17½	11	14	23½	11	11
23...	24	14	16	24	24	.....	17	13	10	23½	24	24	24
24...	16	24	24	24	18	.....	12½	17	24	.....	17½	17½	24
25...	15¾	17½	9½	24	24	.....	15	15½	13½	10½	23½	9½	24
26...	13½	15	15	24	24	.....	13	12½	12	23½	24	24	24
27...	4	24	24	24	24	.....	12½	13½	23½	10	16	9	9
28...	24	23	24	13½	24	.....	17½	6½	16½	24	24	24	24
29...	24	17	24	24	24	.....	17½	16	24	24	20	9½	24
30...	24	24	24	24	24	.....	18½	17	18	10	24	24	24
31...	24	24	24	24	24	.....	12½	17	20½	3½	10	24	24

This condition may be read off of the charts. On Chart 2, the average day of the maximum month required five out of six pumps

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running at Baden with six pumps running to meet the maximum days. On Chart 3, the average day of maximum month required five pumps out of six available with five pumps running up to full speed to meet the maximum days, leaving only pump 14, and at times a Baden pump for reserve. This margin of available reserve is precariously small. Although the consumption curves of the charts are drawn through the high points and therefore represent extreme conditions, yet these may recur and must be met. The consumption curves in fact may be slightly short of true high pumping values, being based on even monthly averages. Periods of greater or less than a month's time may be selected, which show higher average consumptions, as was the case of the thirty-four days from July 4th to August 8th, 1916. If during this period we omit Sundays, the average day of the maximum period will exceed that of the maximum month by five million gallons a day.

Assuming the charts then as a fair prediction of future consumptions, pump 13 becomes necessary on Baden service as a reserve and consequently the Bissell's Point service is in immediate need of additional pumping capacity, as the five pumps remaining are all necessary for the maximum months, leaving no reserve whatever.

Because of this acute condition, it is recommended that immediate steps be taken to provide funds for a new turbine-driven centrifugal pump, for the Bissell's Point service, with the view toward having the same ready for service for the summer of 1920.

While the centrifugal type of pump is less economical than the triple expansion crank and fly wheel type, it is considered desirable to install the centrifugal pump because of its present low cost compared with the triple expansion pump and because of the probable slow deliveries on the latter. In the future, the centrifugal pump may be moved to the Baden station or the Chain of Rocks station and be replaced by a triple expansion pump.

### ENGINEERING OFFICE.

The usual detail and repair work incidental to the maintenance of the plants was looked after, together with the following larger projects:

Plans and specifications, for the suction and discharge piping valves and fittings, on the 110-million-gallon turbine-driven centrifugal pump at the Chain of Rocks were completed, and contracts awarded. Most of this material has been delivered. The installation of the pump has been delayed somewhat, due to priority of Government work in the contractor's shop.

A study and preliminary drawings were made for the installation of a complete coal and ash handling equipment for the Sanitarium boiler room.

Most of the attention of the office was devoted to preparing plans in final detail, and specifications for the carrying out of the work outlined in last year's report on the Baden station reconstruction. Contracts have been awarded for the complete coal and ash handling machinery, including track hopper, coal storage bins and ash hopper, for four 425 H. P. boilers, for eight chain grate stokers each having an area of eighty-five square feet, for the brick and tile for the boiler settings, for the breeching, for the structural steel work for supporting the boilers and attendant galleries, for the sheet steel breeching, and for the main steam pipes, valves and fittings.

Plans and specifications were drawn, and contracts let for the new 48-inch high and low pressure distribution manifolds at Bissell's Point. The inspection of the valves, pipes and fittings was under the superintendence of the office, and although the program of construction was delayed for several months, due to the crowded condition of the shops and strikes, most of the material has been delivered.

Inspection has been carried on at the A. P. Smith shops for the Distribution Section.

Experiments were conducted on the boiler furnace arches at Bissell's Point to determine the best shape of arch and bridge wall to maintain a prompt ignition with the inferior coals at hand.

### CHAIN OF ROCKS.

JOHN F. SCHMIDT, Engineer-in-Charge.

The total pumping at the Chain of Rocks station amounted to 39,317,500,000 gallons, as compared with 37,296,050,000 gallons last year, an increase of 5.2 per cent.

The average elevation of the wet well for this year was 81.2, and the average net head including a friction head of 8.35 feet was 59.3 feet, or an increase of 1 foot more than for last year.

The average cost of pumping one million gallons at this station amounted to \$3.20 as against \$2.437 for the previous year. This shows an increase of \$0.763 per million gallons (31.2 per cent). As was mentioned before, this increase was expected, due to the advance in cost

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of materials and labor. A better comparison this year would be from a coal basis, as shown at the beginning of this report.

During the year, 235,371,000 pounds of steam were generated, which were distributed as follows:

31,283,700 pounds for electric generation.	13.3 per cent
10,176,000 pounds for heating.....	4.3 per cent
193,911,300 pounds for pumping.....	82.4 per cent

### Engine Room.

The chief activity at this station was in making arrangements for the new 110-million-gallon turbine-driven centrifugal pump, to be known as Low Service Pump No. 10. A rock ledge along the east wall of the pit has been removed, giving an additional floor space of 200 square feet. This space gives more working clearance around the new unit. A sixty-inch suction conduit connecting with the wet well has been cut through forty feet of solid rock. A stop log gate has been installed on the opening of this conduit in the wet well. A 60-inch hydraulically operated gate valve has been installed on the conduit as it enters the middle pit. The concrete foundation for the unit has been finished, as has also the steam piping. Everything is in readiness for the installing of the unit and piping. The pump contractor will not be able to make delivery as contemplated.

While the above work was progressing, numerous other changes had to be made. The electric elevator was moved to the north pit, the two electrically driven sump pumps were moved to the north side of the pit and connected into a common discharge line, eliminating several bends. A new sump pump was also cut into the rock. The old steam driven sump pump has been discarded. The wet vacuum pumps for Low Service Pumps Nos. 4 and 5 have been rearranged on a platform with provision for the installation of the wet vacuum pump for the new unit. Thus all these small pumps will be in one locality and will be visible and accessible. The hot well has been moved to make room for the 60-inch discharge from the new pump.

Oiling galleries have been installed on Low Service Engines Nos. 6, 7, 8 and 9. These afford an easy and safe way to inspect and oil the upper valve gear. Metallic packing on the valve gears has been renewed and repaired where needed. Two new hot wells have been installed on the compound engines. These are steel tanks lined with concrete. A central oil storage and filter system has been installed in the middle pit. This eliminates the small tanks on each engine and adds

to the cleanliness of the plant. Hydraulic cylinders have been installed on the 42-inch suction valves on Low Service Engines Nos. 6, 7, 8 and 9.

New bronze impellers were put in Centrifugal Pumps Nos. 4 and 5. The pattern was made in our shop and the castings in a local foundry. The saving was considerable.

New tubes have been put in several of the condensers and numerous minor repairs have been made to keep up and improve where necessary, the efficiency which the plant has attained.

### **Boiler Room.**

A gallery along the rear of the boilers and immediately below the drums has been completed. It affords an easy and safe way for the men to inspect and enter the steam drums.

The superheaters on the six National Boilers Nos. 1 to 6 were originally installed between the top row of tubes and the shells. In this location they never generated the specified superheat. Various arrangements of experimental baffling were installed in one of the boilers, in an attempt to get better circulation of the gases or either hotter gases traveling through the superheater. The superheater, however, being located near the end of the gas travel through the tubes, caused every arrangement of baffling which gave higher superheat, to raise the flue gas temperature excessively. As a consequence of these experiments, and because of the success of the superheaters located in the combustion chambers of Boilers 7 and 8, all superheaters will hereafter be placed in the combustion chambers. Owing to the cramped space available for the superheaters in the combustion chambers of Boilers Nos. 1 to 6, it has been found necessary to keep a high gas temperature at this point, and the successful result of experiments on baffling to attain this end is shown in Figure 1.

A new 3" high pressure auxiliary steam line has been installed, replacing the old one, which contained cast iron fittings and was unsuitable for superheated steam.

In addition to the above, the usual repair and alteration work was done to keep up the efficiency of the boiler room.

### **Generator House.**

The Generator House has been kept in first class working order; minor repairs and alterations have been taken care of, but no extensive changes have been made or contemplated.

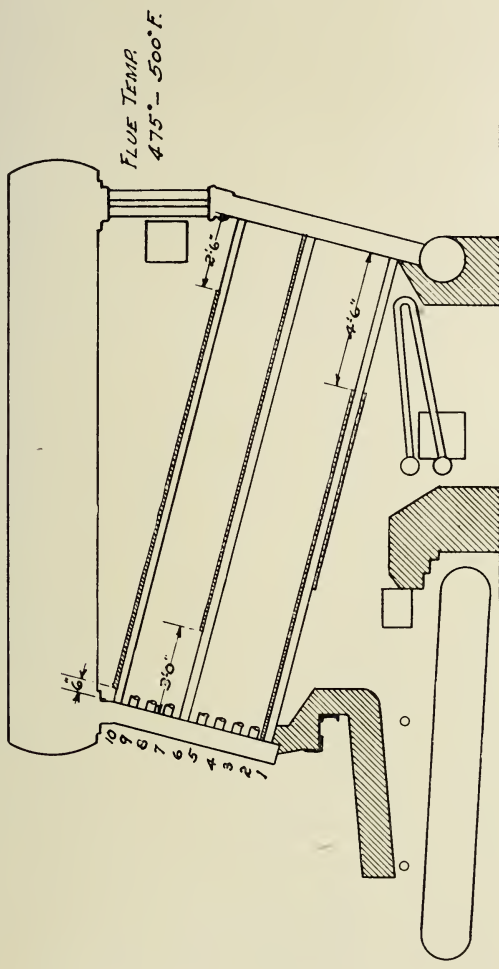
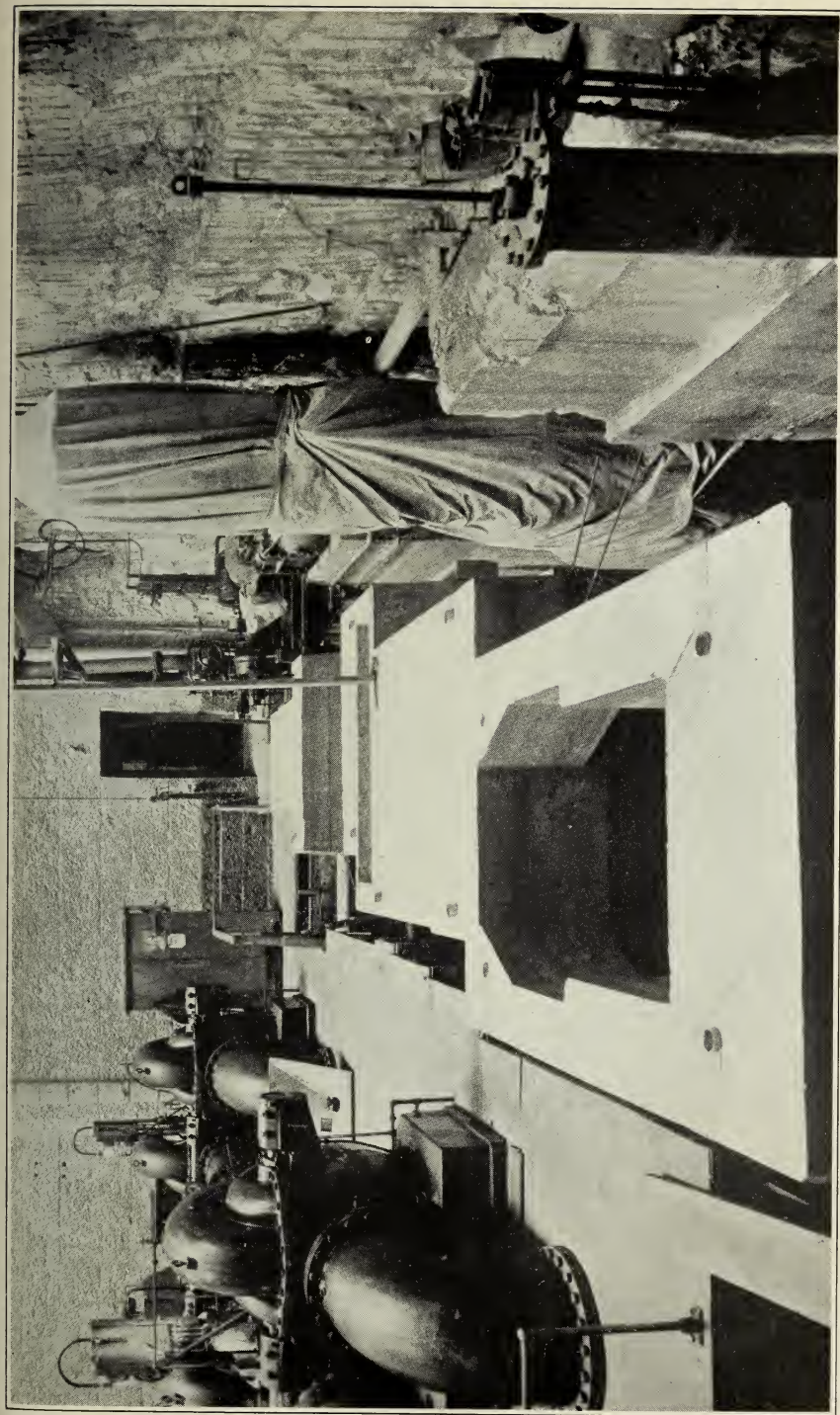


FIGURE 1.





FOUNDATION PLAN FOR NEW 110 M. G. D. STEAM TURBINE DRIVEN CENTRIFUGAL PUMP

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Following is a report of the total output from the Generator House, the unit costs and the distribution of power:

### Chain of Rocks Station.

	Unit No. 6 250 K. W. 550 V. D. C. Generator	Unit No. 7 250 K. W. 550 V. D. C. Generator	Unit No. 8 75 K. W. 550 V. D. C. To 2300 V. A. C. Motor Generator	Unit No. 9 75 K. W. 550 V. D. C. To 2300 V. A. C. Motor Generator	Total
Generator Output in K. W. H.	515,214	522,372	146,068	155,813	1,037,586
Distribution Output in K.W.H.	306,646	304,159	146,068	155,813	912,686

COSTS		DISTRIBUTION		
At Switchboard		Where Used	Number of K. W. H. Furnished	Cost
Operating and Maintenance.....	\$ 8,064.19	L. S. Station.....	112,489 D.C.	\$2,565.74
Steam.....	12,154.20	Railway.....	94,180 "	2,106.52
Material.....	209.35	Coagulant House—Power...	127,280 "	2,934.51
Electrician and Helper.....	447.57	Coagulant House—Lights...	28,179 "	647.71
Total Switchboard Cost.....	\$20,875.31	Filter Plant—Power.....	262,856 "	6,103.99
Line Maintenance.....	153.23	Filter Plant—Lights.....	80,877 A.C.	1,849.97
Total.....	\$21,028.54	Laboratory.....	48,000 "	1,108.52
Per Kilowatt Hour		Chain L. S. Station.....	102,525 "	2,411.38
Generation.....	0.0201	" Park Lights.....	42,300 "	972.92
Distribution.....	0.023	Tunnel Drainage.....	14,000 "	327.28
		Total.....	912,686	\$21,028.54

The switchboard cost for electric generation for the year 1916-1917 was \$0.00915 per kilowatt hour; that for this year was \$0.0201 per kilowatt hour, showing an increase of 120 per cent.

This large increase in cost is due in part to the high cost of material and labor and in the main to the correction in the method of figuring steam charges. In previous years costs were figured on a basis of five pounds of coal per kilowatt hour, no allowance being made for labor and maintenance. During the last year, the drawing up of the reports on electric generation was transferred to the Operating Section. Steam charges are now based on twenty pounds of steam per kilowatt hour, as determined in last year's annual report (1916-1917, page 127), and on the cost of producing steam. To this determined cost of steam for generation are then added the costs of operating, maintenance, material, electrician and helper, chargeable to electric generation.

### Machine Shop.

The milling machine for the hand hole plates, which was described in last year's report, has been provided with multiple cutters. All of the water legs have been faced and the work completely finished.

The work done in the machine shop includes the repairs and improvements for the Boiler and Engine Room and the Generator House, also work for the Filter Plant, Coagulant House, Screen Chambers and Intake Towers.

### **BISSELL'S POINT.**

HARRY O. BERGER, Engineer-in-Charge.

The year just past marked the close of the first complete year with H. S. Engine Rooms Nos. 1 and 2 running on steam generated in the one boiler room. There were hopes of attaining a large reduction in the cost of pumping through this change, but as previously mentioned, the stoker arches in combination with the inferior grade of coal available gave unsatisfactory results. The arches are not correctly designed for economically burning the poorer bituminous coals, and considerable study and testing is being carried on with a view of determining the shape of arch that will give the desired results. The new brick stack with connections to the breeching has been completely erected and is now in successful operation.

The usual pumping records were tabulated, showing that these stations pumped 22,525,617,895 gallons of water as compared with 21,525,591,210 gallons for the preceding year, an increase of 4.65 per cent.

#### **No. 1 Engine Room.**

Except for short periods this engine room was run on steam generated in No. 2 boiler room.

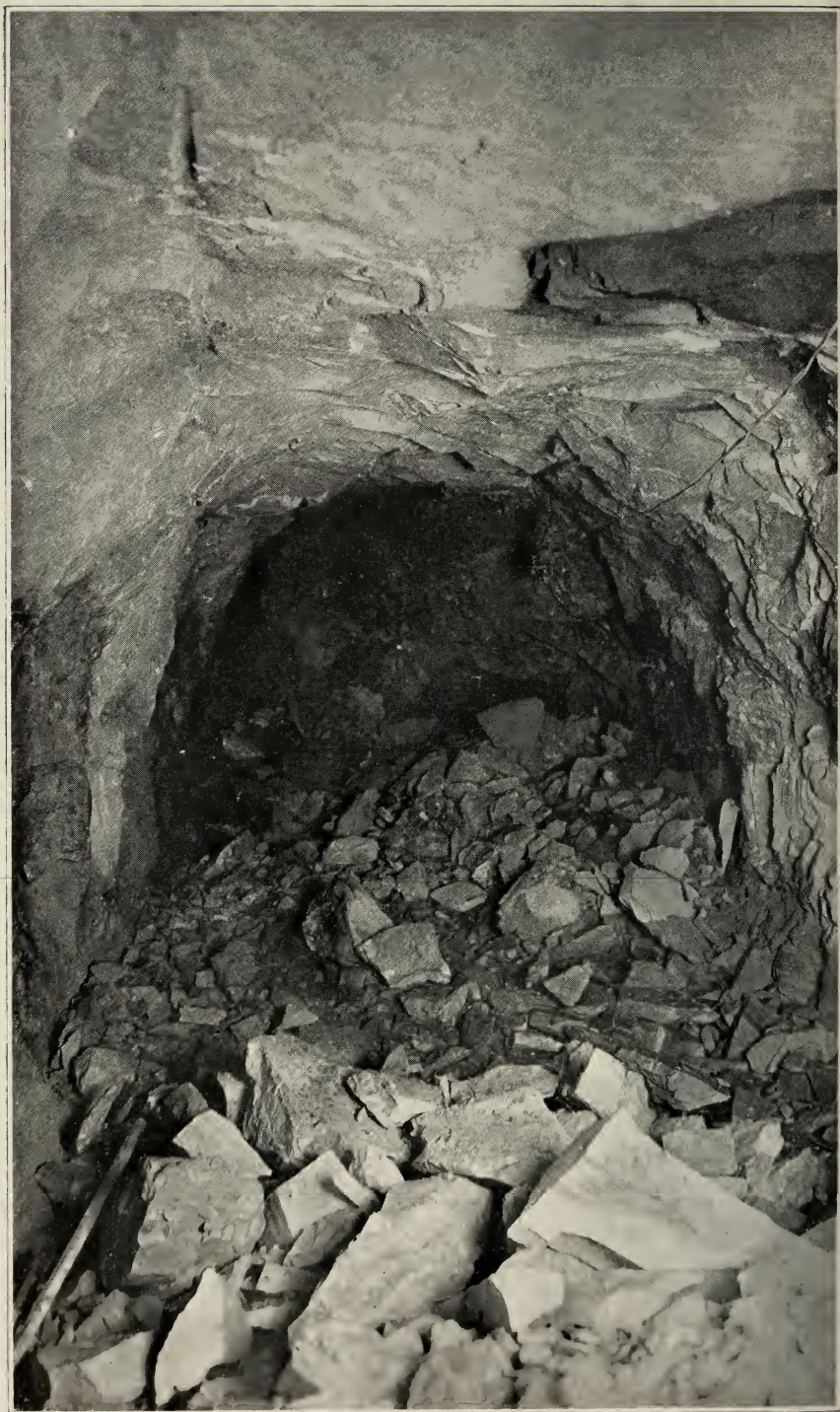
The central oiling system, including cabinets located in very accessible positions, has been completed and is in successful operation. It is an improvement both in appearance and economy over the old system.

The usual repair work to keep the efficiency of this engine room up to its standard has been done throughout the year. No large changes were contemplated. The three engines in this house pumped 12,902,721,117 gallons of water for the past year, as compared with 12,208,380,760 gallons for the preceding year, an increase of 5.7 per cent.

#### **No. 2 Engine Room.**

Owing to the demand of Government work, the contractor for the turbine-driven centrifugal pump has been unable to make changes on this unit in order to attain his duty guarantee, and accordingly has accepted payment on the forfeiture basis, with the understanding that





60-INCH TUNNEL LEADING FROM WET WELL TO NEW 110 M.G.D.  
STEAM TURBINE DRIVEN CENTRIFUGAL PUMP.

at some future date he may be able to improve the efficiency of the pump and obtain his guaranteed duty. This pump has been used very little during the past year. Its actual running time was 120 hours, during which time it pumped 120,396.628 gallons of water.

An oiling gallery for the upper valve gear on H. S. Engines Nos. 6 and 13 has been completed. This enables the workmen to inspect and oil these gears easily and with great safety.

No important changes were made in this house during the past year. Numerous small alterations were made in order to keep the engines and appurtenances in first class condition.

For the year just past, these engines pumped 9,622,896,778 gallons of water and for the preceding year 9,317,210,450 gallons, an increase of 3.3 per cent.

### **No. 2 Boiler Room.**

The superheater on Boiler No. 5 sprung leaks. This caused considerable difficulty, as the superheater is hung in the side walls of the boiler setting, and the only way to thoroughly inspect the elements was to remove the superheater from the chamber, which necessitated the removal of considerable steam piping. The superheater was tested to an hydrostatic pressure and all elements showing the least sign of leaking and those that were sagged were removed and renewed.

The new superheaters will be placed in the combustion chambers, and those for Boilers Nos. 1, 2, 3 and 4 have arrived. Work of installation will start shortly. These boilers have been operating without superheaters for the past year. As mentioned in a previous report the superheaters on these boilers were installed in the side wall. After eight years of service they were pitted out and it was decided to replace them with superheaters located in the combustion chamber. This new location has proven very successful on Boilers Nos. 7 and 8 at the Chain of Rocks, where they have been in operation for two years. The advantages over the original location are accessibility and less superheater surface required.

\* Automatic stop and check valves have been ordered for Boilers Nos. 1, 2, 3 and 4. These will be installed when the new superheaters and steam piping is erected.

A reclaiming belt conveyor was designed and installed in the coal storage shed adjoining No. 2 boiler room. This conveyor is so arranged that coal can be easily transferred to the main conveyor, which will carry it to the coal bunkers in the boiler room. A coal unloader was designed and erected on the main conveyor whereby the

coal, after being crushed, can be unloaded in the storage shed. Both conveyor and unloader have proven themselves handy and have increased the storage capacity of this house 600 tons.

The chain grate stokers, which buckled and broke, due to insufficient clearance in the links, have given very little trouble during the past year.

A new and simple twin elbow for the steam jet ash conveyor has been installed. This eliminated the many segments of the long radius bends and the large number of joints which were difficult to keep tight.

### **Machine Shop.**

All minor repair work for the engines and boilers has been done in this shop, and in addition work for several of the other departments.

### **BADEN.**

GEO. A. HOFFMAN, Engineer-in-Charge.

During the past year Mr. Geo. A. Hoffman was made Engineer-in-Charge of the Baden station.

The Baden station carried the entire high pressure load for the year just past. No help was received from No. 13 engine at Bissell's Point. The total pumping amounted to 15,564,298,400 gallons, as compared with 14,139,294,700 gallons for the preceding year, an increase of 10.1 per cent.

A number of important changes have been made which have materially reduced the coal consumption. These changes will be mentioned later.

### **Boiler Room.**

The eight 277 H. P. boilers at this station have been overhauled. New tubes were put in where needed. Several of the down draft furnaces were provided with new drums and tubes and the baffle tile were reset and locked in a permanent position.

All boiler walls were made air-tight.

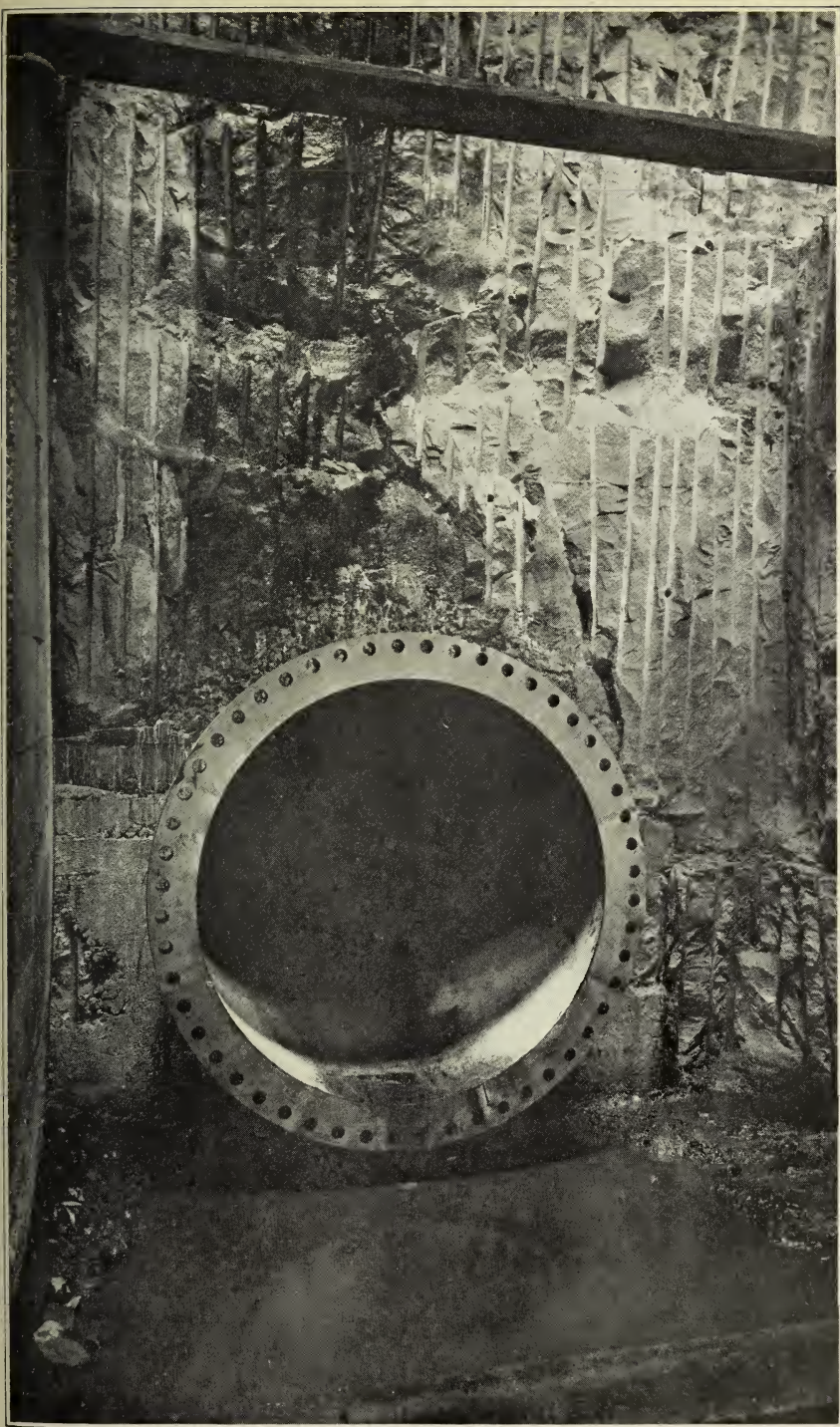
The safety valves were readjusted, tested and reset.

All gate valves were repacked and seats reground where needed.

The Venturi tube on the feed water meter was cleaned.

Foundations for the new coal bunkers have been started.

All minor apparatus is being moved preparatory to the reconstruction of the station.

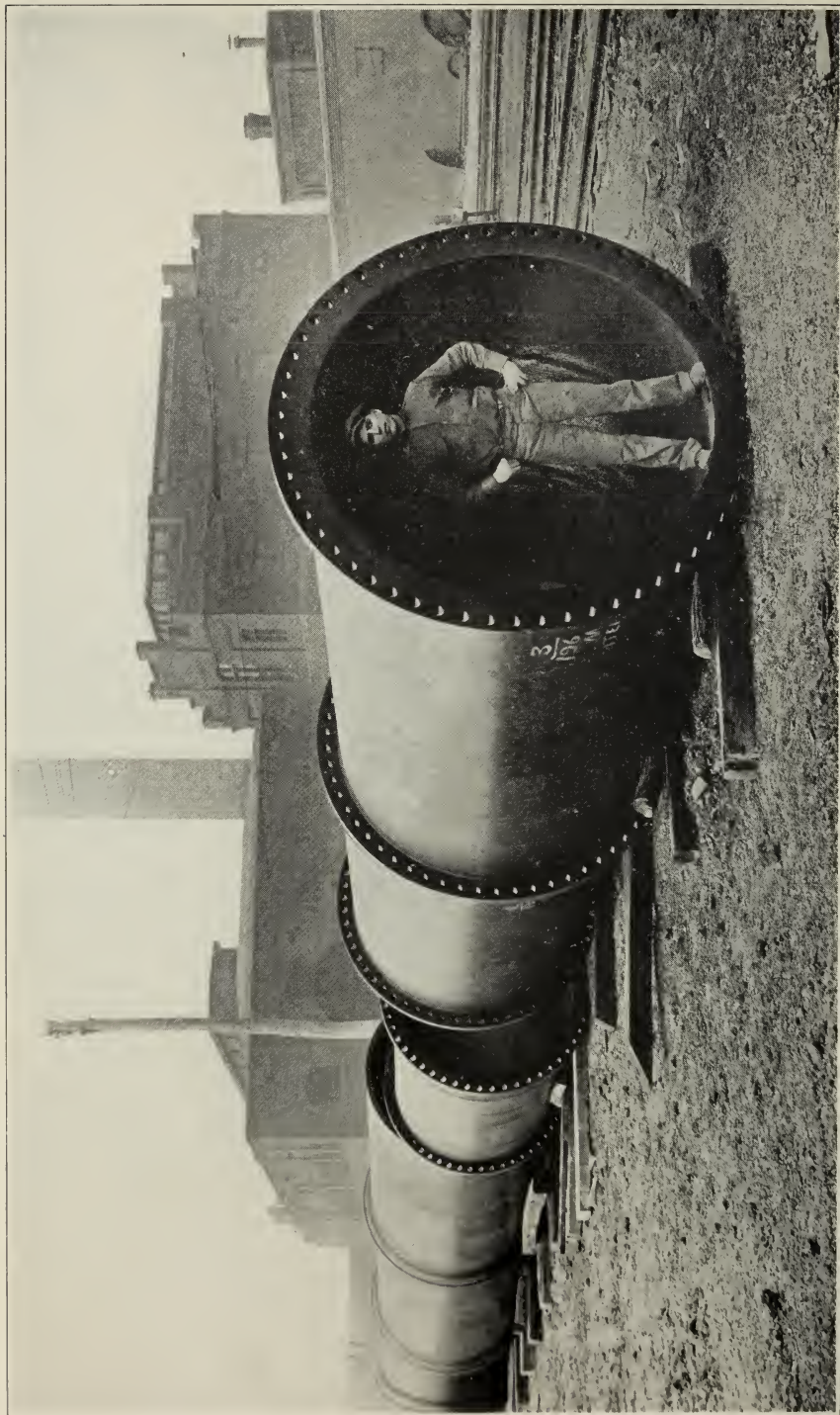


60-INCH SUCTION CONNECTION FOR NEW 110 M. G. D. STEAM  
TURBINE DRIVEN CENTRIFUGAL PUMP.

Also showing rock wall cut away, giving additional floor space in pit.

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72-INCH DISCHARGE PIPE FOR NEW 110 M. G. D. STEAM TURBINE DRIVEN CENTRIFUGAL PUMP.

### Engine Room.

The valve gears on Engines Nos. 9 and 10 functioned improperly under variations in steam pressure. When the steam pressure dropped, the H. P. steam hook would not disengage, with the result that full steam pressure would be admitted for the entire stroke. The steam lap was  $\frac{5}{16}$ " on a 6" diameter valve. New steam valves and stems were made and reset in a no-lap position, with the result that now the engine runs smoothly and evenly under varying steam pressure. No appreciable difference was noticed in the admission.

The valve gears on Engines Nos. 7, 8, 11 and 12 were tested and rearranged.

A duplicate feed water header was erected along the west wall of the engine pit. This header extends from the hot wells on the various engines to the feed water filters in the boiler room.

The traps on all drains connected to the steam headers have been put in first class condition.

A multicoil heater was installed on Engines Nos. 7 and 8 to which all trap drains from the engines and also from Engines Nos. 9 and 10 have been connected, in order to reclaim the heat from the trap drains for the make-up water.

### Machine Shop.

Almost all work done for outside departments has been done in this shop. During the past year work was done for the Supply and Purifying Section, Distribution Section, Department of Streets and Sewers, and all Municipal Power Plants. In fact, most of the work at this shop has been for outside branches and sections.

A very successful cylinder grinder for automobile engines was designed and constructed in this shop.

The usual upkeep work, such as regrinding valves, facing valve cages and valves, altering pipe work, etc., incidental to the maintenance of this station has been done.

### Generator House.

The equipment has been kept in a good working condition.

The demand on this house has exceeded that of the previous year by 131,878 kilowatts.

Below will be found an itemized report of the electric generation and costs in this house for the past year:

### Baden Station.

	Unit No. 1 24 K. W. 110 V.D.C. Generator Machine Shop	Unit No. 2 250 K. W. 550 V.D.C. Generator	Unit No. 3 250 K. W. 550 V.D.C. Generator	Unit No. 4 85 K. W. 550 V. D. C. To 2,300 V.A.C. Motor Generator	Unit No. 5 100 K. W. 550 V. D. C. To 2,300 V.A.C. Motor Generator	Total
Generator Output in K. W. H. . . .	7,100	509,272	390,586	96,420	194,040	906,958
Distribution Output in K. W. H. . .	7,100	353,662	133,836	96,420	194,040	785,058

COSTS		DISTRIBUTION		
At Switchboard		Where Used	Number of K. W. H. Furnished	Cost
Operating and Maintenance. . . . .	\$8,933.13	H. S. Stations and Water Towers. . . . .	12,500DC	\$ 269.72
Steam. . . . .	6,298.64	Railway. . . . .	459,698 "	9,835.82
Material. . . . .	639.13	Machine Shop—Crane. . . .	7,100 "	150.21
Electrician and Helper. . . . .	338.45	Missouri Naval Reserves. . .	4,888AC	99.45
Total Switchboard Cost. . . . .	\$1,609.35	Baden Machine Shop. . . . .	15,300DC	327.55
Line Maintenance. . . . .	612.90	H. S. Sta. and Water Tower. .	244,772AC	5,262.65
Total. . . . .	\$16,822.25	Elec. Shop and Pass. Sta. . .	10,200 "	219.20
		Bissell's Point Office. . . . .	12,000 "	257.92
		Baden Park Lights. . . . .	9,000 "	193.41
		Bissell's Point Park Lights. .	9,600 "	206.32
		Total. . . . .	785.058	\$16,822.25
Per Kilowatt Hour				
Generation. . . . .	\$0.01743			
Distribution. . . . .	0.02143			

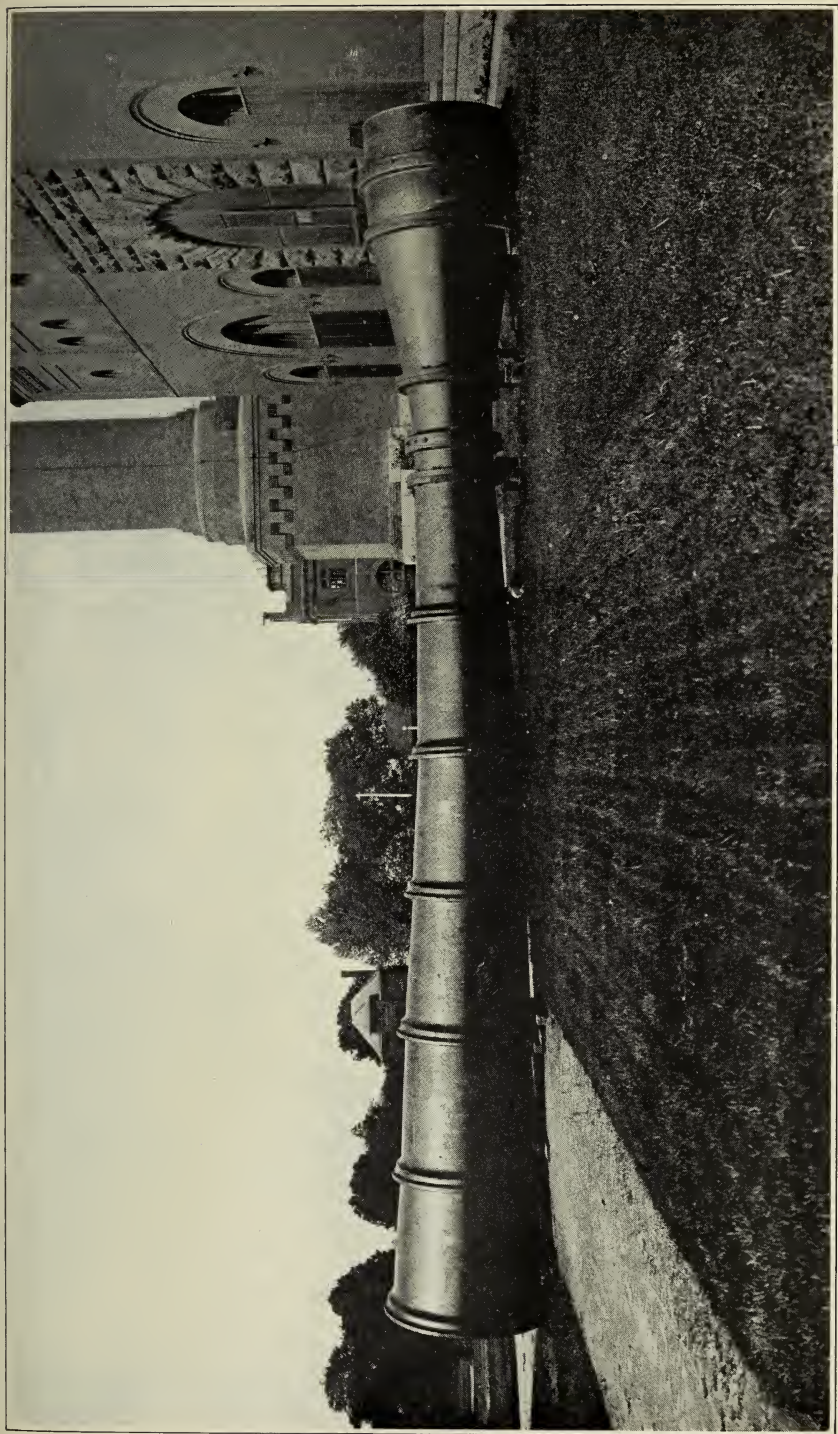
### SANITARIUM.

JOHN G. BERNARD, Engineer-in-Charge.

During the past year Mr. John G. Bernard was transferred from Assistant at the Chain of Rocks to Engineer-in-Charge of the Sanitarium Station.

This station has shown a marked improvement during the past year in intelligent manipulation of the apparatus.

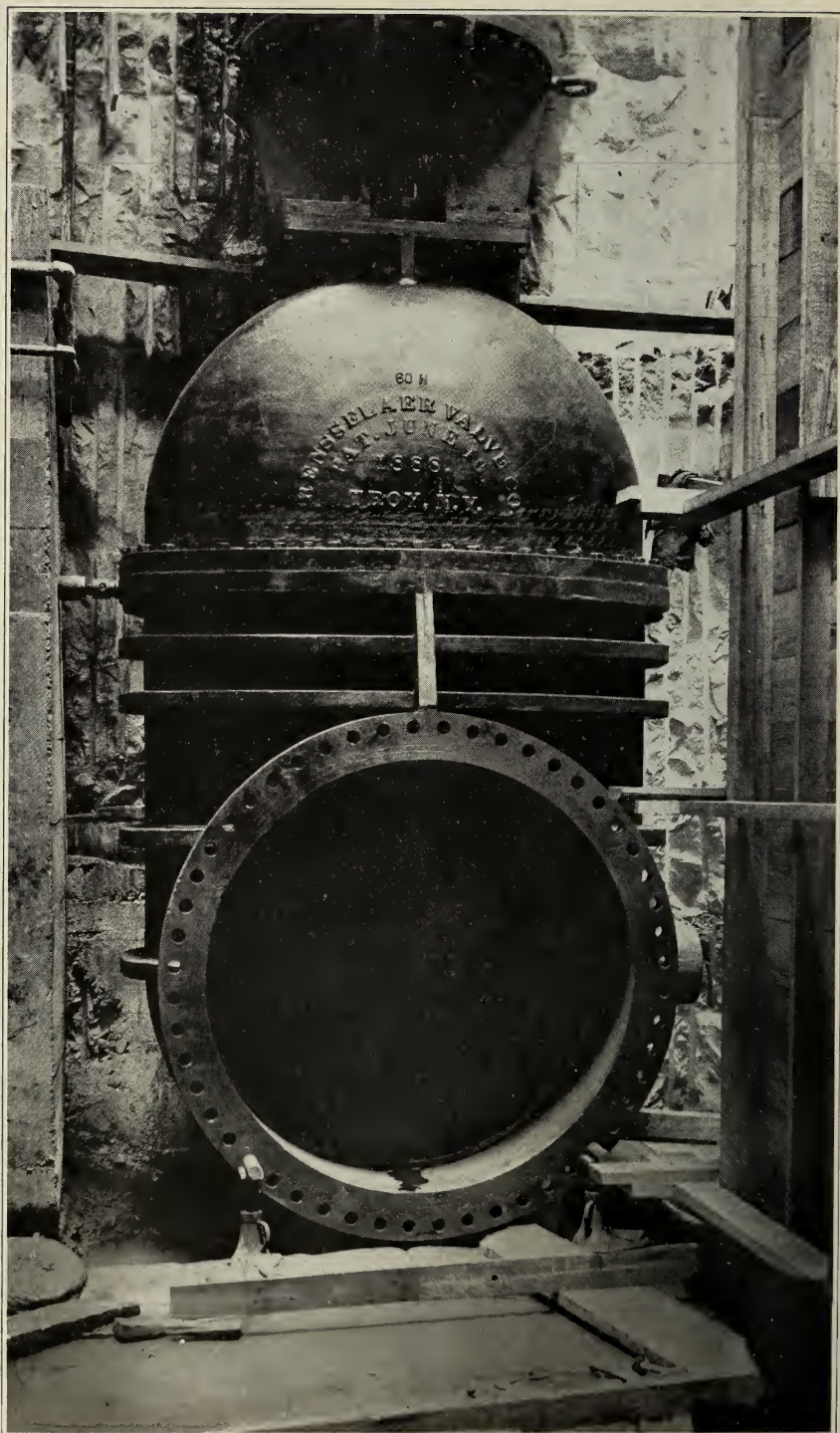
Last year's annual report reviewed the investigation of the complete heating system of the main buildings. The past summer was devoted to readjusting and overhauling the entire system, with the result that during the extremely cold past winter every hall was comfortably warm, a condition that did not prevail in past years. During former years the load on the boiler room was a source of considerable worry, whereas, the past year, due to a readjusted system, this was eliminated.



72-INCH VENTURI METER TUBE FOR NEW 110 M. G. D. STEAM TURBINE DRIVEN CENTRIFUGAL PUMP.

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60-INCH HYDRAULICALLY OPERATED GATE VALVE FOR NEW  
110 M. G. D. STEAM TURBINE DRIVEN CENTRIFUGAL PUMP.

### Boiler Room.

A system of levers, by which the dampers can be regulated from the front of the boiler, has been installed on each boiler. This enables the fireman to control the draft on his boiler conveniently with resultant closer attention.

A new sump pump was installed in the ash tunnel to take the place of the original one, which was considerably worn, due to long and continuous service. The old pump is being completely overhauled in the Baden machine shop.

The stoker engine and all boiler feed pumps and all appurtenances in the boiler room have been kept in first class working order.

### Engine Room.

Chief among the alterations, repairs and improvements may be mentioned the following:

The steam end on No. 2 pump was dismantled and the piston rod was "trued up," the steam valves were scraped and new metallic packing was put in the new glands on the H. P. cylinder.

New rubber valves were put in in Nos. 1 and 2 pumps.

No. 2 D. C. engine generator was provided with new metallic packing for the piston rod.

The main bearings and quarter boxes on the ice machine were babbitted and the machine put in working order for the coming summer.

The 6" Davis reducing valve on the steam line to the kitchen and laundry was replaced by a new one.

The hot water pipes to the main building and also the maniacal building were found to contain considerable scale. They were cleaned and put in good order. A new concrete pit 14'x14'x3' deep was made in the engine room basement to accommodate the three boiler feed pumps and the two Bundy tilt traps. These pumps were placed in small pits in the boiler room in very dark, inaccessible locations. The change has given a clear passageway in back of the boilers, has placed the pump closer to the heaters and in a more prominent place. The Bundy traps handle the condensate from the main building. By placing them in this pit the condensate will flow to them and will reduce the back pressure which was necessary to force the condensate to the traps at the higher location.

Several changes and rearrangement of steam pipe and drains on the heating system were made.

## Ice Plant.

All apparatus was cleaned and overhauled, being put in working order for the coming season. The ammonia condenser was cleaned and the distilled water filters were put in order.

The following is an itemized account of the cost of production of the various outputs:

## Sanitarium Station.

Report of Electric Generation, Refrigeration, Pumping and Steam  
For One Year from April 1st, 1917, to April 1st, 1918.

## ELECTRIC GENERATION.

Total Output in K. W. Hours. . . . . 771,831

OPERATING AND MAINTENANCE COST  
SWITCHBOARD.

Labor. . . . .	\$ 3,831.37
Repairs, Maintenance, Auxiliaries. . . . .	1,410.05
Steam. . . . .	5,329.50
Supplies. . . . .	232.21
Total. . . . .	\$10,803.13
Cost per K. W. Hr.—Switchboard. . . . .	.014

## DISTRIBUTION.

WHERE USED	K.W.Hrs.	Cost
Infirmary and Infectious Disease Hospital—A.C.	\$131,644	\$1,895.59
Sanitarium—Light, D.C.	325,606	4,644.66
Sanitarium—Power D.C.	314,581	4,262.88
Total. . . . .	771,831	10,803.13

## REFRIGERATION.

## Operating and Maintenance Cost.

	Ice	Refrig.	Total
Labor. . . . .	\$2,712.31	\$1,428.60	\$4,140.91
Repairs, Maintenance, Aux. . . . .	\$70.42	488.34	1,358.76
Ice, \$310.55			
Steam. . . . .	714.22	355.05	1,069.27
Supplies. . . . .	244.37	145.05	389.42
Total. . . . .	\$4,541.32	\$2,417.04	\$6,958.36

## Distribution.

Where Used	Tons Ice	Tons Refrigeration	Cost
Infirmary and Infectious Disease Hospital. . . . .	619		\$2,391.64
Sanitarium. . . . .	541	1,116	4,566.72
Total. . . . .	1,160	1,116	\$6,958.36
Cost per Ton Ice. . . . .			\$3.915
Cost per Ton Refrigeration. . . . .			2.166

## PUMPING.

Total U. S. Gallons Water Pumped. . . . .	288,654,555
Pounds Steam Used. . . . .	3,463,080
Pounds Steam per Million Gallons. . . . .	12.000

OPERATING AND MAINTENANCE  
COST.

Labor. . . . .	\$3,831.35
Repairs, Maintenance and Auxiliaries. . . . .	1,363.64
Steam. . . . .	917.74
Supplies. . . . .	233.83
Total. . . . .	\$6,346.56

Cost per Million Gallons. . . . . \$ 21.96

## STEAM.

Pounds Coal Burned. . . . .	41,467,500
Pounds Water Evaporated. . . . .	259,378,021
Pounds Water per Pound Coal. . . . .	6.25
Pounds Ash Removed. . . . .	12,284,400
Per Cent Ash. . . . .	29.6%

OPERATING AND MAINTENANCE  
COST.

Coal. . . . .	\$50,641.17
Labor. . . . .	9,120.49
Repairs. . . . .	9,932.94
Supplies. . . . .	1,267.33
Total. . . . .	\$70,961.93

Coal Cost per 1000 lbs. Steam. . . . . \$ 0.1952

Total Cost per 1000 lbs. Steam. . . . . 0.2735

## DISTRIBUTION.

WHERE USED	Pounds Steam	Cost
Electric Generators. . . . .	19,295,775	\$ 5,329.50
Ice Machine. . . . .	4,123,200	1,069.27
Pumps. . . . .	3,463,080	917.74
Sanitarium and Infirmary. . . . .	232,495,966	63,645.42
Total. . . . .	259,378,021	\$70,961.93

Tables showing detailed figures of the work of the Operating Section are hereto appended, as follows:

Table 35. Average daily consumption of water per month in millions of U. S. gallons.

Table 36. Amount of coal burned at the Low Service Station, Chain of Rocks, per million U. S. gallons of water pumped into settling basins.

Table 37. Amount of coal burned at the High Service Station, Baden, per million U. S. gallons of water pumped to the City.

Table 38. Amount of coal burned at the High Service Station, Bissell's Point, per million U. S. gallons of water pumped to the City.

Table 39. Cost of producing steam, Low Service Station No. 2, Chain of Rocks.

Table 40. Cost of producing steam, High Service Station No. 3, Baden.

Table 41. Cost of producing steam, High Service Station Nos. 1 and 2, Bissell's Point.

Table 42. Cost of pumping 1,000,000 gallons of water at the various stations.

Table 43. Cost of pumping 1,000,000 gallons of water against a head of one foot.

Table 44. Daily pumping, Low Service Engines, Chain of Rocks.

Table 45. Daily pumping, High Service Engines, Baden.

Table 46. Daily pumping, High Service Engines, Bissell's Point.

Table 47. Daily consumption of water, April 1st, 1917, to March 31st, 1918.

Table 48. Low Service Engines, Chain of Rocks, record of work done by Low Service Engines, months of April, 1917, to March, 1918.

Table 49. High Service Engines, Station No. 3, Baden.

Table 50. High Service Engines, Stations Nos. 1 and 2, Bissell's Point.

Table 51. Record and cost of work done by High and Low Service Engine during 365 days, ending March 31st, 1918.

Respectfully submitted,

L. A. DAY,

Engineer-in-Charge, Operating Section.

TABLE No. 35. AVERAGE DAILY CONSUMPTION OF WATER PER MONTH IN MILLIONS OF U. S. GALLONS.

YEAR	January	February	March	April	May	June	July	August	September	October	November	December	Average
1872	12.5	13.1	12.0	12.5	13.0	15.0	15.9	16.9	16.5	16.1	15.1	15.7	14.5
1873	16.1	15.5	14.6	13.8	14.2	16.6	18.0	19.4	18.5	17.8	16.4	15.7	16.4
1874	16.2	15.5	21.3	17.5	17.5	20.0	20.1	19.4	19.7	18.6	17.8	18.8	17.9
1875	21.1	21.7	21.3	18.7	18.9	19.6	20.1	21.9	22.2	21.8	18.8	15.5	20.1
1876	17.3	16.9	16.1	17.4	20.1	22.0	23.4	27.2	24.8	24.5	21.2	12.6	20.9
1877	23.5	20.4	19.8	19.1	20.8	22.7	24.9	24.3	25.4	23.7	20.0	20.6	22.3
1878	20.8	19.6	20.1	22.0	23.1	22.5	26.3	25.9	25.4	25.0	23.2	22.8	23.0
1879	29.0	24.6	22.6	21.6	24.8	26.0	27.0	28.5	25.3	25.7	23.2	22.9	25.0
1880	21.3	21.2	19.5	21.8	24.1	25.5	28.0	30.0	28.8	27.4	27.1	27.7	25.1
1881	31.8	28.1	26.3	27.7	27.4	29.5	28.0	29.4	27.6	26.8	26.1	26.8	27.5
1882	26.1	25.0	26.1	26.1	28.1	29.5	28.8	30.3	29.4	28.8	28.3	28.4	28.0
1883	30.5	27.7	25.0	22.7	26.6	29.0	28.4	30.3	28.6	25.2	26.8	26.5	27.5
1884	26.3	20.7	23.7	19.8	22.7	24.3	27.4	30.3	28.7	26.8	23.9	26.9	24.8
1885	30.0	29.5	23.9	22.6	24.4	27.4	29.5	30.3	28.8	27.0	24.7	25.7	26.9
1886	28.8	28.5	24.9	25.2	28.4	30.7	34.5	34.6	33.1	31.7	29.0	31.0	30.5
1887	33.6	30.5	27.3	26.9	30.3	31.8	36.7	36.6	35.5	32.7	30.1	29.0	32.7
1888	25.4	27.3	29.0	29.4	33.1	33.7	37.4	39.2	36.5	33.4	29.6	27.8	32.7
1889	27.3	28.4	29.7	30.5	32.9	33.5	37.4	42.8	36.5	33.4	29.3	29.0	32.3
1890	28.5	28.4	29.7	31.1	33.1	40.2	44.1	45.3	40.0	37.4	35.2	32.4	35.2
1891	38.1	32.3	32.0	34.5	38.4	41.4	45.7	51.7	47.7	41.8	36.8	35.6	38.6
1892	38.4	34.7	33.9	35.3	37.9	44.4	52.6	57.6	50.2	47.1	40.9	43.8	42.1
1893	46.7	43.8	41.1	45.4	51.1	59.9	64.6	64.0	60.5	57.0	58.4	35.4	47.5
1894	42.6	43.0	46.8	52.3	56.1	63.3	58.6	61.8	60.5	56.3	51.7	46.3	52.9
1895	50.6	55.8	49.6	49.9	53.4	51.8	58.2	65.6	57.9	51.7	49.6	48.1	55.2
1896	47.0	43.5	43.1	43.3	48.7	55.9	60.2	61.9	65.2	60.0	50.2	44.3	51.1
1897	46.2	45.0	47.3	46.6	49.8	62.8	64.6	63.8	62.0	56.8	56.4	55.0	52.6
1898	49.2	49.7	47.3	46.6	56.0	62.8	64.6	67.8	69.2	61.8	54.2	58.1	60.8
1899	54.0	69.5	55.1	54.0	60.3	65.3	71.4	82.5	73.9	66.6	60.2	56.3	63.5
1900	59.7	57.5	55.7	54.6	62.3	70.0	82.2	82.5	68.0	67.1	64.1	62.5	65.8
1901	57.1	57.5	55.3	55.2	68.9	69.6	72.9	72.2	73.9	66.6	60.2	65.9	65.8
1902	60.2	67.8	61.0	59.3	68.9	69.3	78.6	74.3	68.0	67.0	65.4	67.5	68.1
1903	64.9	63.9	66.1	61.6	73.6	81.0	87.4	91.2	74.6	70.6	66.3	70.0	77.7
1904	71.9	72.7	66.2	68.3	69.5	78.5	75.8	79.9	89.2	84.2	76.0	63.0	72.1
1905	74.6	86.0	66.9	67.0	69.5	81.0	87.4	82.1	73.7	68.7	64.3	63.2	70.4
1906	62.6	65.2	62.1	65.0	73.3	73.5	80.3	79.6	79.8	72.2	65.8	63.2	70.4
1907	60.3	63.4	62.7	64.7	67.1	72.4	82.4	82.1	79.4	73.0	67.4	65.1	69.2
1908	60.6	61.8	64.3	62.3	66.4	73.1	80.3	81.1	81.7	71.8	67.4	65.1	69.2
1909	70.3	65.8	71.0	62.0	71.0	78.0	80.8	89.1	79.0	73.0	69.5	76.0	73.7
1910	73.7	73.6	73.9	72.1	71.7	79.8	82.2	84.0	81.9	78.5	73.5	73.0	76.5
1911	73.8	70.8	71.7	71.7	84.1	94.1	97.2	89.9	87.5	81.8	76.1	72.4	81.0
1912	83.0	84.7	76.6	75.0	83.5	85.5	98.8	92.0	94.9	85.2	78.8	83.8	83.8
1913	75.0	75.2	72.4	73.0	84.1	97.5	99.1	104.8	93.9	82.3	76.0	72.9	84.0
1914	72.7	81.3	77.0	82.1	84.1	116.8	113.0	105.7	94.4	87.4	82.7	87.0	91.1
1915	89.1	81.0	80.7	87.9	86.2	91.2	93.3	90.3	95.0	91.2	87.6	86.6	88.7
1916	88.9	87.4	81.8	81.9	91.0	93.5	116.3	109.5	102.4	96.9	93.0	95.1	94.8
1917	95.2	104.8	92.1	92.1	94.0	106.4	116.9	113.4	102.6	96.7	91.7	108.3	94.8
1918	125.9	109.7	94.1	92.1	94.0	106.4	116.9	113.4	102.6	96.7	91.7	108.3	101.2

TABLE No. 36.

Amount of coal burned at the Low Service Station, Chain of Rocks,  
per million U. S. gallons of water pumped into settling basins:

YEARS	Bushels of Coal Used	U. S. Gallons Water Pumped	Bushels of Coal Used per Million Gallons of Water Pumped
1895-1896.....	233,636	18,537,270,000	12.6
1896-1897.....	236,614	19,083,797,000	12.4
1897-1898.....	264,176	19,736,240,000	13.4
1898-1899.....	306,276	21,275,720,000	14.4
1899-1900.....	320,346	22,734,160,000	14.4
1900-1901.....	322,267	22,996,750,000	14.0
1901-1902.....	362,309	25,045,431,000	14.5
1902-1903.....	365,954	26,072,841,000	14.0
1903-1904.....	429,866	29,562,451,175	14.5
1904-1905.....	593,424	33,133,190,950	17.9
1905-1906.....	494,003	26,333,992,700	18.8
1906-1907.....	504,025	26,681,562,820	18.9
1907-1908.....	410,209	28,048,016,860	14.6
1908-1909.....	404,443	29,156,106,490	13.9
1909-1910.....	436,541	34,201,970,040	12.8
1910-1911.....	460,900	33,909,601,570	13.6
1911-1912.....	441,636	35,161,390,720	12.5
1912-1913.....	456,379	34,975,114,020	13.0
1913-1914.....	454,267	33,684,104,480	13.5
1914-1915.....	502,466	34,656,290,000	14.5
1915-1916.....	510,878	34,690,430,000	14.7
1916-1917.....	472,738	37,296,050,000	12.7
1917-1918.....	484,924	39,317,500,000	12.3

TABLE No. 37.

Amount of coal burned at the High Service Station, Baden, per  
million U. S. gallons of water pumped to the City:

YEARS	Bushels of Coal Used	U. S. Gallons Water Pumped	Bushels of Coal Used per Million Gallons of Water Pumped
*1897-1898.....	45,482	1,136,237,000	40.0
1898-1899.....	340,015	10,063,552,000	33.8
1899-1900.....	364,994	10,361,610,000	35.2
1900-1901.....	436,436	11,894,274,000	36.7
1901-1902.....	492,135	12,926,515,000	38.1
1902-1903.....	523,263	13,106,743,000	39.9
1903-1904.....	616,743	15,573,515,926	39.6
1904-1905.....	652,327	17,677,773,370	36.9
1905-1906.....	648,627	16,720,901,370	38.8
1906-1907.....	622,032	14,004,299,640	44.4
1907-1908.....	502,806	12,582,799,450	40.0
1908-1909.....	534,845	13,296,961,310	40.2
1909-1910.....	525,705	12,837,299,030	41.0
1910-1911.....	535,999	13,276,673,120	40.4
1911-1912.....	620,640	14,448,006,120	43.0
1912-1913.....	660,118	14,948,527,450	44.2
1913-1914.....	652,094	15,736,282,870	41.4
1914-1915.....	535,693	14,007,709,200	38.2
1915-1916.....	528,800	13,792,018,600	38.3
1916-1917.....	528,698	14,139,294,700	37.4
1917-1918.....	510,794	15,564,298,400	32.8

\* Started December, 1897.

TABLE No. 38.

Amount of coal burned at the High Service Station, Bissell's Point,  
per million U. S. gallons of water pumped to the City:

YEARS	Bushels of Coal Used	U. S. Gallons Water Pumped	Bushels of Coal Used per Million Gallons of Water Pumped
1885-1886.....	788,781	9,817,943,000	80.3
1886-1887.....	866,633	10,877,896,000	79.7
1887-1888.....	902,477	11,520,608,000	78.3
1888-1889.....	873,406	11,481,771,000	76.1
1889-1890.....	933,154	11,863,457,000	78.6
1890-1891.....	931,791	13,144,465,000	70.9
1891-1892.....	1,105,050	14,453,390,000	76.4
1892-1893.....	1,197,163	16,140,476,000	74.1
1893-1894.....	1,282,025	17,366,270,000	73.8
1894-1895.....	1,396,450	20,030,271,000	69.7
1895-1896.....	1,501,861	19,542,768,000	76.8
1896-1897.....	1,418,970	18,653,013,000	76.1
1897-1898.....	1,251,918	18,299,938,000	68.6
1898-1899.....	773,877	10,736,759,000	72.1
1899-1900.....	865,041	11,752,651,000	73.6
1900-1901.....	884,531	11,087,465,000	79.8
1901-1902.....	929,293	11,598,606,000	80.1
1902-1903.....	925,267	11,076,904,000	83.5
1903-1904.....	606,976	10,033,897,753	60.5
1904-1905.....	469,974	11,165,545,040	42.1
1905-1906.....	289,354	8,460,404,600	34.2
1906-1907.....	360,650	11,604,914,060	31.1
1907-1908.....	432,602	12,660,121,980	34.2
1908-1909.....	408,307	12,511,600,560	32.6
1909-1910.....	505,604	14,692,428,180	34.4
1910-1911.....	510,009	14,506,007,740	35.1
1911-1912.....	518,227	15,958,001,340	32.5
1912-1913.....	474,983	15,002,371,960	31.7
1913-1914.....	470,605	15,206,575,920	30.9
1914-1915.....	505,388	19,960,925,920	25.3
1915-1916.....	469,503	18,934,741,760	24.8
1916-1917.....	528,706	21,525,591,210	24.6
1917-1918.....	570,201	22,525,617,895	25.4

TABLE No. 39.

COST OF PRODUCING STEAM, LOW SERVICE STATION No. 2,  
CHAIN OF ROCKS.

1917-1918 Month	Pounds Coal Burned	Cost of Coal	Labor and Material in Boiler Room	Total Cost of Producing Steam	Total Evaporation	Coal Cost per 1000 lbs. of Steam	Total Cost per 1000 lbs. of Steam
April.....	5,207,500	\$ 3,135.33	\$ 2,416.75	\$ 5,552.08	15,998,000	\$ 0.196	\$0.347
May.....	3,584,600	3,503.95	2,379.55	5,883.50	17,052,000	0.205	0.345
June.....	3,094,000	3,024.39	2,684.67	5,709.06	15,731,000	0.192	0.363
July.....	4,009,500	4,220.00	2,612.59	6,832.59	20,986,000	0.201	0.326
August.....	3,909,100	4,153.42	2,717.49	6,870.91	21,340,000	0.195	0.322
September.....	3,884,300	5,428.31	2,496.90	7,925.21	19,760,000	0.275	0.401
October.....	3,953,900	5,525.58	2,558.98	8,084.56	19,706,000	0.280	0.41
November.....	4,122,000	6,275.75	2,455.33	8,731.08	19,710,000	0.318	0.443
December.....	4,814,800	7,691.64	2,587.75	10,279.39	22,844,000	0.337	0.45
January.....	4,930,300	7,876.15	2,689.47	10,565.62	24,750,000	0.318	0.427
February.....	3,852,500	6,154.37	2,508.22	8,662.59	19,403,000	0.317	0.446
March.....	3,725,800	5,951.97	2,634.99	8,586.96	18,091,000	0.329	0.475
Average.....	3,924,025	\$ 5,245.07	\$ 2,561.89	\$ 7,806.96	19,614,250	.267	.398
Total.....	47,088,300	\$62,940.86	\$30,742.69	\$93,683.55	235,371,000		

TABLE No. 40.

COST OF PRODUCING STEAM, HIGH SERVICE STATION  
No. 3, BADEN.

1917-1918 Month	Pounds Coal Burned	Cost of Coal	Labor and Material in Boiler Room	Total Cost of Producing Steam	Total Evaporation	Coal Cost per 1000 lbs. of Steam	Total Cost per 1000 lbs. of Steam
April.....	3,251,850	\$ 2,699.04	\$ 3,860.23	\$ 6,559.27	20,826,000	\$0.13	\$0.315
May.....	3,639,210	3,020.54	3,952.14	6,972.68	22,474,000	0.134	0.310
June.....	3,419,940	2,838.55	4,146.07	6,984.62	21,388,000	0.133	0.327
July.....	3,983,190	3,604.29	3,765.90	7,370.19	25,795,000	0.14	0.286
August....	3,884,930	3,515.86	3,491.99	7,007.85	25,701,000	0.137	0.273
September.	3,721,649	5,201.01	3,514.02	8,715.03	24,359,000	0.214	0.358
October....	3,972,890	5,552.11	3,574.23	9,126.34	25,001,000	0.222	0.365
November..	3,619,880	5,782.76	3,869.77	9,652.53	23,466,000	0.246	0.411
December..	4,039,300	6,452.28	4,093.32	10,545.60	25,735,000	0.251	0.410
January...	4,515,820	7,214.02	3,940.08	11,154.10	27,616,000	0.261	0.404
February...	3,517,850	5,619.77	3,872.02	9,491.79	21,949,000	0.256	0.432
March.....	3,518,430	5,620.69	3,659.80	9,280.49	22,415,000	0.251	0.414
Average...	3,757,078	\$ 4,760.08	\$ 3,811.63	\$ 8,571.71	23,902,083	\$ 0.198	\$0.359
Total.....	45,084,938	\$57,120.92	\$45,757.57	\$102,878.49	286,725,000	.....	.....

TABLE No. 41.

COST OF PRODUCING STEAM, H. S. STATIONS Nos. 1 and  
No. 2, BISSELL'S POINT.

1917-1918 Month	Pounds Coal Burned	Cost of Coal	Labor and Material in Boiler Room	Total Cost of Producing Steam	Total Evaporation	Coal Cost per 1000 lbs. of Steam	Total Cost per 1000 lbs. of Steam
April.....	3,403,200	\$ 2,606.10	\$ 3,473.54	\$ 6,079.64	19,018,000	\$0.1370	\$0.32
May.....	3,437,300	2,792.80	3,479.09	6,271.89	18,421,000	0.1516	0.34
June.....	4,095,245	3,327.43	4,363.99	7,691.42	23,227,000	0.1430	0.331
July.....	4,466,280	3,963.58	4,981.72	8,945.30	25,540,000	0.1550	0.35
August....	3,770,220	3,345.88	4,620.96	7,966.84	21,475,000	0.1550	0.371
September.	3,238,000	4,525.11	4,319.14	8,844.25	17,603,000	0.257	0.50
October....	3,441,500	4,810.20	3,832.10	8,642.30	17,719,000	0.271	0.487
November..	3,287,200	5,251.30	3,901.84	9,153.14	17,509,000	0.30	0.523
December..	4,470,700	7,141.94	3,709.14	10,851.08	24,001,000	0.298	0.452
January...	5,554,900	8,873.95	3,556.78	12,430.73	27,508,000	0.323	0.452
February...	4,226,500	6,751.83	3,492.06	10,243.89	21,352,000	0.316	0.480
March.....	3,703,800	5,916.82	3,912.43	9,829.25	19,992,000	0.296	0.492
Average...	3,916,237	\$ 4,942.25	\$ 3,970.23	\$ 8,912.48	21,113,750	\$ 0.234	\$0.425
Total.....	47,094,845	\$59,306.94	\$47,642.79	\$106,949.73	253,365,000	.....	.....

TABLE No. 42.

## COST OF PUMPING 1,000,000 GALLONS OF WATER AT THE VARIOUS STATIONS.

1917-1918 Month	H. S. Stations Nos. 1 and 2			H. S. Station No. 3			H. S. Station No. 2		
	Coal	Labor and Material	Total	Coal	Labor and Material	Total	Coal	Labor and Material	Total
April.....	\$1.482	\$4.278	\$5.76	\$2.273	\$6.057	\$8.33	\$0.849	\$1.971	\$2.82
May.....	1.664	4.296	5.96	2.272	5.508	7.78	0.948	1.852	2.80
June.....	1.704	4.135	5.84	2.126	6.094	8.22	0.809	2.151	2.96
July.....	1.813	4.107	5.92	2.35	4.68	7.03	1.13	1.57	2.70
August.....	1.618	4.122	5.74	2.278	4.662	6.94	1.16	1.59	2.75
September.....	2.64	4.800	7.44	3.813	4.757	8.57	1.73	1.583	3.313
October.....	2.81	4.980	7.79	4.17	4.82	8.99	1.52	1.81	3.33
November.....	3.268	5.428	8.696	4.65	4.87	9.52	1.69	1.80	3.49
December.....	3.321	4.164	7.485	4.165	5.285	9.45	1.76	1.60	3.36
January.....	3.45	3.454	6.904	4.325	4.735	9.06	1.96	.92	2.88
February.....	3.27	4.450	7.720	4.106	5.674	9.78	1.49	1.69	3.18
March.....	3.273	5.144	8.417	4.049	5.421	9.47	1.552	1.878	3.43
Average.....	\$2.533	\$ 4.292	\$6.825	\$3.305	\$ 5.679	\$8.984	\$1.310	\$ 1.890	\$3.200

TABLE No. 43.

## COST OF PUMPING 1,000,000 GALLONS OF WATER AGAINST A HEAD OF ONE FOOT.

	Coal Cost	Labor and Material	Total
H. S. Station No. 1 and No. 2.....	\$0.0137	\$0.0232	\$0.0369
H. S. Station No. 3.....	0.0115	0.0197	0.0312
Low Service Station No. 2.....	0.0222	0.0320	0.0542

TABLE No. 44. DAILY PUMPING, LOW SERVICE ENGINES—CHAIN OF ROCKS, 1917-1918.

Day	April	May	June	July	August	September	October	November	December	January	February	March
1.....	96.2	92.6	94.0	103.8	118.9	108.5	109.8	100.9	82.5	135.1	131.1	89.4
2.....	94.9	100.6	94.6	120.6	138.6	121.1	97.5	106.3	86.6	105.8	140.5	105.6
3.....	105.1	99.6	83.7	116.9	135.7	99.4	107.8	103.1	80.9	114.1	127.3	87.7
4.....	93.3	100.3	109.1	113.9	126.0	117.5	91.0	93.5	102.2	118.1	123.6	87.4
5.....	90.0	87.1	100.5	111.6	127.1	122.1	90.6	101.0	99.7	116.9	139.5	97.7
6.....	84.9	87.6	106.9	117.0	133.5	114.2	101.3	99.2	102.5	90.7	138.3	103.8
7.....	95.9	99.6	106.5	118.0	86.1	105.9	90.1	100.9	94.1	126.6	106.2	96.4
8.....	80.7	107.1	97.8	117.0	116.8	87.0	99.0	95.9	101.7	130.7	110.4	97.6
9.....	93.8	95.1	102.6	122.7	116.8	109.2	94.3	90.5	124.2	118.8	112.2	93.7
10.....	96.7	95.1	78.7	126.9	105.2	107.4	107.2	86.7	131.4	128.5	85.5	98.6
11.....	95.0	106.4	103.8	128.9	116.0	107.4	87.3	100.9	128.4	125.6	123.9	98.7
12.....	100.6	94.1	105.7	124.8	107.8	96.6	106.7	100.9	132.8	144.9	102.3	103.9
13.....	94.2	75.2	105.8	124.5	119.9	104.5	105.9	109.3	146.5	156.5	113.1	95.2
14.....	87.2	107.8	100.1	113.7	126.7	107.7	105.9	109.3	133.4	163.1	119.0	105.4
15.....	52.2	75.9	108.6	102.2	122.3	107.7	95.8	127.8	137.4	160.9	122.0	79.5
16.....	108.8	122.3	103.6	114.2	124.5	101.6	99.9	100.6	127.2	144.9	97.8	95.6
17.....	91.1	100.4	91.8	112.5	109.4	99.9	93.4	99.9	115.0	121.5	86.1	96.1
18.....	105.6	107.9	112.2	119.0	116.5	124.8	104.9	101.6	114.1	132.2	105.3	98.5
19.....	125.2	91.0	104.8	114.7	107.2	109.7	87.5	112.1	110.0	137.2	86.1	92.9
20.....	124.0	98.7	114.0	117.5	112.9	100.7	92.3	107.5	111.1	143.5	107.9	117.1
21.....	96.2	111.2	115.1	131.0	124.1	100.7	92.3	93.0	113.3	143.5	117.7	99.6
22.....	98.5	120.2	122.4	127.1	111.2	88.6	93.9	82.7	90.6	142.1	115.7	96.7
23.....	102.4	114.6	122.4	132.6	113.6	102.0	100.0	112.8	94.9	122.0	119.5	80.3
24.....	103.3	119.7	113.7	130.8	104.3	105.4	87.1	74.5	88.0	139.1	89.9	91.4
25.....	108.4	118.5	122.4	137.5	103.7	109.0	101.8	98.7	92.3	112.9	105.2	93.7
26.....	97.8	105.5	132.2	134.9	99.8	109.8	97.3	77.2	92.0	113.9	106.7	106.3
27.....	101.2	93.7	125.1	111.1	105.7	101.0	96.4	113.4	105.5	121.9	109.3	94.3
28.....	91.0	96.8	125.2	124.4	113.5	97.3	87.7	93.7	126.2	135.6	92.1	96.8
29.....	85.7	93.6	118.5	125.0	124.4	95.5	86.8	84.2	127.5	131.6	.....	97.3
30.....	102.2	97.6	113.2	124.0	119.5	90.2	107.0	95.3	128.8	128.2	.....	96.7
31.....	.....	106.6	.....	124.6	104.4	.....	97.4	.....	128.0	131.4	.....	81.3
Average.....	96.7	101.1	109.4	120.8	116.0	104.8	97.6	99.0	115.0	129.5	111.9	96.0

## AVERAGE FOR YEAR.

Maximum Daily Pumping.....	163,110,000
Minimum Daily Pumping.....	52,210,000
Average Daily Pumping.....	107,719,000

TABLE No. 45. DAILY PUMPING, HIGH SERVICE ENGINES—BADEN, 1917-1918.

Day	April	May	June	July	August	September	October	November	December	January	February	March
1	39.7	35.5	34.7	41.9	51.5	47.6	45.7	41.3	41.2	43.6	46.5	38.5
2	44.2	34.4	35.8	49.0	48.4	45.6	45.5	41.8	39.5	45.1	48.0	39.6
3	43.3	32.7	33.9	44.3	36.0	48.3	45.4	42.5	42.8	44.6	43.4	37.2
4	42.6	33.2	38.4	44.3	41.0	47.2	44.9	39.3	41.3	43.9	47.2	38.5
5	34.4	34.5	35.3	48.2	45.8	48.2	45.9	43.5	40.5	42.9	46.0	39.3
6	34.8	32.7	34.2	42.3	47.3	47.8	45.9	41.1	38.4	41.2	44.2	37.9
7	34.9	36.0	36.2	48.1	49.4	45.9	43.9	42.6	38.4	45.1	42.6	37.8
8	33.0	35.1	37.0	42.4	48.0	45.7	45.2	41.9	49.4	44.0	42.2	38.2
9	35.2	35.2	36.2	46.4	46.4	44.4	43.4	42.3	42.6	43.9	40.8	38.9
10	36.0	34.4	35.1	51.4	48.2	47.5	43.7	42.3	42.6	43.2	40.2	36.2
11	35.9	33.6	40.7	49.9	50.5	46.4	42.4	39.5	48.0	47.0	42.2	40.4
12	34.5	36.2	39.6	49.9	45.5	46.1	42.8	42.9	47.6	58.5	40.2	39.5
13	34.8	33.6	36.3	49.4	52.7	46.4	43.7	41.5	47.1	66.2	40.3	39.1
14	35.7	38.2	44.0	41.3	48.7	47.0	41.7	41.2	46.9	63.4	39.1	37.6
15	33.4	64.8	44.7	39.6	43.8	47.2	45.3	40.9	46.3	61.6	38.8	38.3
16	35.7	63.5	42.8	43.4	45.9	43.2	43.6	41.4	42.8	57.1	39.2	38.0
17	36.5	62.7	36.4	45.4	49.3	48.3	43.9	42.2	46.8	46.4	38.0	36.3
18	36.9	52.5	49.9	47.1	52.3	46.4	41.4	39.4	44.4	46.5	41.1	40.6
19	32.5	52.0	41.3	44.8	47.7	46.4	41.2	43.0	42.5	45.9	39.9	39.6
20	24.7	46.5	41.8	46.6	52.3	43.5	41.7	43.0	41.6	44.7	40.8	39.5
21	31.1	47.9	43.4	49.8	46.4	43.1	39.6	42.8	40.6	47.1	42.0	39.2
22	33.0	36.8	47.1	42.3	45.7	44.3	42.7	41.5	42.2	46.2	41.1	43.5
23	38.7	38.2	47.9	42.9	46.4	42.2	41.1	42.4	38.8	45.6	42.4	42.4
24	36.9	35.7	42.9	49.7	46.8	45.7	41.0	38.4	41.2	45.6	37.2	41.4
25	35.4	36.2	53.4	46.2	49.1	44.5	40.9	38.4	39.2	44.0	40.3	42.7
26	34.8	38.4	44.7	46.2	43.6	44.4	40.7	41.1	42.2	44.0	40.4	40.4
27	32.6	33.4	44.7	44.3	43.7	41.9	41.4	40.5	42.5	44.2	38.9	38.9
28	32.4	36.1	47.2	49.4	44.2	43.6	40.0	40.3	44.5	46.2	38.5	38.7
29	32.6	37.3	48.8	43.6	44.2	43.6	42.3	39.0	48.2	44.1	39.4	39.4
30	25.7	33.2	43.1	43.6	51.7	41.9	41.9	47.9	47.9	43.7	40.3	40.3
31	.....	34.9	.....	52.5	46.8	.....	42.1	.....	48.4	45.0	.....	35.4
Average	35.1	39.9	41.5	46.8	46.9	45.5	43.0	41.4	43.3	47.4	41.7	39.2

## AVERAGE FOR YEAR.

Maximum Daily Pumping.....	66,152,600 Gallons.
Minimum Daily Pumping.....	24,677,200 Gallons.
Average Daily Pumping.....	42,641,900 Gallons.

TABLE No. 46. DAILY PUMPING, HIGH SERVICE ENGINES—BISSELL'S POINT, 1917-1918.

Day	April	May	June	July	August	September	October	November	December	January	February	March
1	35.8	60.9	59.4	61.7	67.5	61.6	60.3	53.7	46.6	78.6	78.6	59.8
2	52.1	59.4	57.9	74.1	75.0	46.8	60.8	48.2	41.2	72.6	90.8	56.7
3	52.5	58.5	46.4	69.6	88.6	50.2	62.2	55.9	51.4	72.3	89.7	46.1
4	51.7	56.5	64.3	63.1	87.8	61.0	38.0	44.3	51.9	72.6	82.2	58.8
5	55.8	55.8	60.9	68.6	85.0	61.6	51.3	54.1	53.0	63.6	86.2	61.3
6	57.4	44.7	64.5	67.5	64.9	62.3	52.5	54.1	53.1	61.5	88.2	58.4
7	54.8	60.4	64.4	69.1	62.1	59.9	41.6	55.0	53.1	72.7	69.0	59.4
8	42.5	61.9	65.4	63.9	67.6	51.5	52.8	53.1	59.3	74.2	89.0	57.9
9	56.4	63.0	59.4	75.0	65.1	43.8	53.3	53.5	69.2	74.3	73.6	50.0
10	59.6	60.6	46.1	77.3	66.6	58.5	60.5	50.3	72.3	75.7	49.8	48.6
11	61.5	59.2	64.0	69.3	96.6	61.2	52.8	54.4	80.4	75.7	72.1	57.1
12	58.1	57.7	66.2	74.2	53.1	58.6	59.7	53.3	84.0	90.5	63.2	58.6
13	56.9	46.1	65.5	73.8	72.0	60.4	53.6	54.2	85.9	90.3	59.4	57.9
14	55.6	58.4	62.2	66.6	78.3	60.0	58.4	52.4	86.3	91.9	69.8	57.4
15	44.4	*12.1	56.0	53.9	72.7	64.3	58.0	52.7	82.8	91.0	60.6	49.4
16	57.3	49.9	61.4	70.0	65.6	47.6	59.0	53.5	80.1	82.7	59.6	58.5
17	59.9	38.5	51.4	70.8	66.5	63.8	53.7	49.1	71.3	56.0	47.9	45.3
18	62.2	48.0	69.0	72.9	66.5	63.0	58.4	42.5	72.4	90.7	64.9	56.4
19	63.6	52.4	69.1	69.6	50.1	60.1	54.1	52.4	71.4	84.0	61.4	55.5
20	69.2	43.6	68.1	68.1	70.9	61.3	53.3	53.8	59.8	78.4	65.0	57.8
21	63.4	51.3	74.7	70.7	67.8	52.0	43.9	49.2	57.0	88.9	68.2	60.1
22	51.4	57.9	74.7	70.6	64.5	60.2	53.3	48.6	46.7	89.7	73.1	56.4
23	64.9	58.4	70.3	72.6	61.2	43.9	54.4	43.0	53.5	82.1	67.9	43.2
24	66.7	62.0	60.7	70.9	53.5	63.0	54.3	44.1	53.5	79.5	38.4	52.9
25	66.1	62.2	73.9	73.9	61.2	63.6	54.1	42.1	46.0	73.4	62.2	54.5
26	61.1	59.3	82.8	70.4	47.1	53.4	54.1	51.8	60.4	73.7	62.1	58.6
27	58.8	45.8	80.9	69.7	67.2	56.2	44.5	53.1	70.4	82.1	60.5	57.0
28	52.0	57.6	75.4	77.5	70.9	57.1	51.6	52.9	73.6	81.6	59.4	56.7
29	49.2	60.4	74.2	77.8	62.9	55.5	54.5	39.4	74.1	87.0	.....	54.0
30	55.9	55.9	63.4	77.8	59.5	50.6	55.5	48.0	80.7	86.1	.....	51.9
31	60.1	60.1	.....	82.2	60.4	.....	55.0	.....	80.7	.....	.....	.....
Average	56.6	54.1	65.1	70.2	66.7	57.2	53.6	50.4	64.8	78.8	68.0	54.7

## AVERAGE FOR YEAR.

Maximum Daily Pumping	91,877.770
Minimum Daily Pumping	35,778.890
Average Daily Pumping	61,714.020

\* Abnormally low pumping account break in conduit.

TABLE No. 47. DAILY CONSUMPTION OF WATER, APRIL 1st, 1917 TO MARCH 31st, 1918.  
In Millions and Tenths of Millions U. S. Gallons.

Day	April	May	June	July	August	September	October	November	December	January	February	March
1	74.4	96.0	94.0	99.8	118.4	109.4	106.9	95.0	88.6	115.4	130.1	98.0
2	97.2	94.1	93.3	125.2	125.1	91.9	106.0	89.2	78.8	119.3	136.4	97.8
3	95.7	90.9	80.1	122.9	123.8	99.7	106.5	99.6	94.6	118.0	125.8	82.7
4	94.3	89.6	103.5	103.1	132.1	107.6	98.3	81.4	93.3	115.4	132.1	98.2
5	90.7	90.4	93.9	121.5	125.3	108.3	98.7	98.7	93.6	106.6	133.2	100.0
6	92.4	76.8	98.3	108.6	116.6	110.5	98.7	96.1	92.6	102.1	129.0	97.6
7	89.0	97.4	100.9	119.6	106.0	106.9	84.3	97.0	95.8	119.7	113.8	96.3
8	73.9	97.2	102.4	99.5	115.9	98.9	99.6	95.4	104.5	118.5	115.0	97.1
9	94.8	97.7	94.8	130.8	111.3	86.3	98.9	93.6	111.7	118.5	109.1	93.8
10	96.1	95.0	82.2	128.8	115.3	106.2	102.3	93.9	123.5	118.3	92.2	78.6
11	97.0	92.0	108.0	118.5	117.0	106.7	96.5	79.4	128.8	130.4	113.8	98.1
12	92.5	94.2	107.0	123.9	98.2	104.7	95.6	97.0	130.4	151.4	104.0	97.8
13	91.3	79.5	100.8	124.4	129.7	106.0	100.8	95.3	132.0	151.2	102.0	96.7
14	92.1	96.7	103.3	140.3	127.8	107.4	89.1	93.6	131.5	152.7	105.9	93.8
15	76.7	86.2	101.6	90.8	115.7	113.9	104.2	93.2	127.5	148.0	99.4	94.5
16	94.1	100.9	103.9	116.2	110.5	89.2	103.1	95.1	115.6	137.1	98.8	96.5
17	97.0	101.8	87.0	118.8	116.5	112.4	99.9	92.5	120.1	108.1	87.5	79.8
18	98.8	103.2	114.3	119.4	119.0	109.5	98.2	80.0	116.3	136.1	104.8	99.2
19	97.3	105.6	112.7	114.5	97.1	107.2	95.6	96.1	111.9	123.1	102.3	98.3
20	96.0	86.4	110.6	116.7	122.8	103.2	94.7	96.3	103.4	125.0	107.3	98.0
21	93.3	101.5	115.6	122.0	111.1	97.2	81.2	95.8	103.4	135.4	114.9	97.1
22	81.9	95.6	121.0	103.9	109.0	103.0	97.6	90.8	99.9	134.6	112.0	95.8
23	105.6	96.3	120.3	119.7	108.4	85.9	95.5	91.3	84.9	128.8	113.3	88.6
24	103.1	97.9	96.9	124.2	104.4	108.6	95.1	87.5	95.3	125.1	86.4	76.3
25	99.5	98.3	132.1	115.7	110.6	107.6	95.5	78.7	85.5	117.9	101.3	99.1
26	96.8	98.6	133.9	116.9	90.5	102.1	95.0	93.6	100.5	116.2	102.7	100.1
27	91.7	77.5	122.9	116.4	110.6	98.1	93.6	94.0	103.1	114.1	99.7	96.2
28	86.4	95.5	123.0	127.0	110.4	101.2	82.3	92.3	115.7	130.0	97.3	95.3
29	78.0	100.2	123.9	104.6	104.1	100.2	96.0	77.2	124.8	127.6	97.9	97.6
30	94.4	86.3	109.1	134.6	106.0	88.3	96.8	90.6	122.0	129.5	.....	98.0
31	.....	195.0	.....	132.2	107.2	.....	97.2	.....	128.5	129.5	.....	78.9
Average	92.1	94.0	106.4	116.9	113.4	102.6	96.7	91.7	108.3	125.9	109.7	94.1

## AVERAGE FOR YEAR.

Maximum Daily Consumption	152,665,470
Minimum Daily Consumption	73,942,740
Average Daily Consumption	104,345,075
Maximum Daily Pumping H. S.	156,475,900, January 13th.
Minimum Daily Pumping H. S.	75,474,690, April 1st.
Average Daily Pumping H. S.	104,355,920

TABLE No. 48. LOW SERVICE ENGINES—CHAIN OF ROCKS.

Record of Work Done by Low Service Engines, Months of April, 1917, to March, 1918.

1917-1918 MONTH	Engine No. 4		Engine No. 5		Engine No. 6		Engine No. 7		Engine No. 8		Engine No. 9		Coal in Pounds	Ash in Pounds	U. S. Gallons Water Pumped	Pounds Coal Per Million Gallons
	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.				
April.....	383.30		341.00		104.15		620.45		277.45		405.00		2,515,431	503,086	2,901,910,000	867
May.....	321.00		421.45		244.30		546.45		355.45		488.45		3,037,872	607,574	3,132,360,000	970
June.....	394.45		159.45		346.15		617.00		455.15		457.30		2,675,462	535,076	3,232,810,000	815
July.....	648.30		40.00		597.30		708.30		635.00		567.45		3,528,358	705,672	3,743,110,000	935
August.....	12.45		739.45		706.15		684.30		598.30		650.15		3,418,820	683,764	3,594,320,000	951
September.....	670.30		59.00		514.15		468.30		572.30		527.00		3,418,680	683,736	3,145,350,000	1,081
October.....	325.00		409.00		389.30		540.00		474.30		496.15		3,300,730	660,146	3,026,730,000	1,090
November.....	259.45		423.30		424.30		495.00		330.30		585.15		3,302,240	660,448	2,969,210,000	1,112
December.....	376.30		372.15		560.45		628.15		442.00		623.30		3,802,217	760,445	3,449,740,000	1,102
January.....	407.30		452.30		642.00		671.45		599.15		663.15		3,993,598	798,719	4,013,010,000	995
February.....	499.00		196.15		477.15		399.30		487.45		588.30		2,909,637	581,927	3,133,810,000	928
March.....	430.45		325.30		412.45		595.15		341.30		530.30		2,890,839	578,167	2,975,140,000	972
Total.....	4,729.30		3,940.15		5,419.45		6,975.45		5,570.15		6,583.30		38,793,884	7,758,760	39,317,500,000	980
Equivalent Days.....	197		164		226		291		232		274		.....	.....	.....	.....

TABLE No. 49. HIGH SERVICE ENGINES, STATION No. 3—BADEN.  
Record of Work Done by High Service Engines, Months of April, 1917, to March, 1918, Inclusive.

1917-1918 MONTH	Engine No. 7			Engine No. 8			Engine No. 9			Engine No. 10			Engine No. 11			Engine No. 12			Coal in Pounds	Ash in Pounds	U. S. Gallons Water Pumped	Pounds, Coal per Million Gallons.
	Hrs.	Min.	Revolu- tions	Hrs.	Min.	Revolu- tions	Hrs.	Min.	Revolu- tions	Hrs.	Min.	Revolu- tions	Hrs.	Min.	Revolu- tions	Hrs.	Min.	Revolu- tions				
April.....	195:25		183,900	186:45		187,200	551:15		422,300	457:45		364,800	466:35		363,000	357:05		272,400	2,901,537	580,307	1,062,870,000	2730
May.....	211:25		178,800	218:55		200,100	548:35		433,700	487:35		387,000	589:35		464,500	507:20		395,800	3,392,113	678,425	1,235,191,500	2747
June.....	171:20		163,600	261:15		243,900	454:50		386,300	488:20		411,100	475:10		399,800	354:15		470,200	3,165,590	633,118	1,238,656,100	2563
July.....	187:20		178,300	216:20		200,500	517:45		440,900	649:40		547,900	576:10		484,200	640:05		544,500	3,759,805	751,961	1,450,179,500	2593
August.....	312:35		299,800	313:25		296,200	509:15		439,300	533:40		463,300	563:05		484,200	565:50		491,500	3,654,627	730,925	1,453,533,700	2514
September.....	348:05		334,500	352:00		334,000	376:50		326,200	594:30		518,600	503:35		436,200	470:50		409,700	3,488,621	697,724	1,364,469,800	2558
October.....	308:05		380,700	439:20		413,300	409:00		358,200	470:55		412,300	461:45		406,500	431:20		379,100	3,748,128	749,626	1,331,797,900	2814
November.....	332:25		311,900	387:25		377,700	408:40		412,400	341:15		308,900	471:10		406,500	405:15		357,600	3,219,265	643,853	1,242,250,600	2592
December.....	305:35		294,900	316:00		303,700	543:25		485,500	441:50		367,600	476:15		427,100	472:35		422,400	3,498,634	699,727	1,343,366,400	2607
January.....	360:50		344,900	355:00		342,200	585:00		518,900	441:40		391,700	548:35		489,400	497:00		442,900	3,979,426	795,885	1,469,630,600	2707
February.....	269:00		257,400	307:05		293,300	395:50		350,200	396:05		348,400	406:30		359,900	440:20		388,900	2,978,495	595,699	1,158,936,100	2570
March.....	220:05		210,000	199:55		191,000	567:15		501,400	336:45		300,100	526:40		466,600	411:15		365,700	3,077,311	615,462	1,214,423,200	2555
Total.....	3,312:10		3,138,700	3,553:25		3,374,100	5,427:40		5,075,300	5,610:00		4,821,700	6,065:05		5,187,900	5,753:10		4,940,700	40,863,552	8,172,712	15,564,298,400	2626
Equivalent Days.....	138			148			226			234			253			240						

Total, Hours..... 27,721:30  
Total Revolutions..... 26,538,400  
Engines Nos. 7 and 8 pumped..... 425 gallons per revolution.  
Engines Nos. 9, 10, 11, and 12 pumped..... 639 gallons per revolution.

TABLE No. 50. HIGH SERVICE ENGINES, STATIONS No. 1 AND No. 2—BISSELL'S POINT.  
Record of Work Done by High Service Engines—Months of April, 1917, to March, 1918.

1917-1918 MONTH	Engine No. 1			Engine No. 2			Engine No. 3			Engine No. 6			Engine No. 13			Engine No. 14	Coal in Pounds	Ash in Pounds	U. S. Gallons Water Pumped	Pounds of Coal per Million Gallons
	Hrs.	Min.	Revolu- tions	Hrs.	Min.	Revolu- tions	Hrs.	Min.	Revolu- tions	Hrs.	Min.	Revolu- tions	Hrs.	Min.	Revolu- tions					
April.....	342:10		274,460	537:35		426,340	534:15		423,820	523:05		478,250	624:35		572,050		3,286,404	657,281	1,699,019,160	1,934
May.....	367:11		298,590	560:25		446,430	474:30		380,760	426:15		390,920	628:25		576,620		3,437,300	887,460	1,678,207,640	2,048
June.....	638:15		529,410	545:05		450,470	346:50		285,920	567:45		543,770	699:35		660,360		4,093,245	819,049	1,952,185,350	2,098
July.....	651:25		561,030	495:55		423,320	457:00		395,520	698:25		691,040	731:10		792,950		2,186,193,260	893,256	2,068,349,760	2,043
August.....	513:00		430,920	572:05		486,320	439:15		414,880	604:35		615,830	688:25		697,010		4,466,280	754,044	1,714,566,560	1,871
September.....	358:45		295,600	542:35		452,060	520:55		432,510	572:50		560,790	666:10		445,760		3,238,000	647,600	1,663,064,740	1,888
October.....	490:05		415,490	406:00		349,380	571:45		484,060	572:50		343,760	521:50		509,690		3,431,990	686,398	1,510,617,480	2,064
November.....	451:55		372,164	544:45		450,510	384:35		328,740	343:35		326,460	378:55		372,530		3,089,087	617,819	2,009,417,150	2,044
December.....	512:10		429,230	651:20		563,100	434:10		386,970	477:40		501,080	669:25		683,070		4,171,626	834,325	2,442,635,145	2,076
January.....	802:35		518,740	635:25		567,330	603:40		529,595	705:33		753,610	716:10		757,760		5,231,900	1,046,390	1,905,204,420	2,142
February.....	492:50		420,890	430:00		367,670	593:05		508,280	530:15		537,880	567:25		577,740		3,903,500	780,700	1,696,157,230	2,049
March.....	364:50		297,510	544:20		450,360	553:05		457,340	387:30		371,980	610:50		579,300		3,494,541	698,908		2,060
Total.....	5,785:10		4,844,034	6,465:30		5,433,290	5,963:05		5,028,395	6,179:03		6,135,370	7,302:55		7,154,840		45,616,093	9,123,220	22,525,617,895	2,025
Equiv. days..	241			270			249			258			305							

Total Hours..... 31,065.43.  
Total Revolutions..... 28,595,925.  
Engines Nos. 1, 2 and 3 pumped..... 843 gallons per revolution.  
Engine No. 6 pumped..... 715 gallons per revolution.  
Engine No. 13 pumped..... 715 gallons per revolution.

TABLE No. 51. RECORD AND COST OF WORK DONE BY HIGH AND LOW SERVICE ENGINES DURING  
365 DAYS ENDING MARCH 31st, 1918

H. S. Stations Nos. 1 and 2.

Engine No.	Time Running		Revolutions	U. S. Gallons Pumped	Coal	Ashes	Remarks
	Hrs.	Min.					
1.....	5.75	10	4,844,034	4,083,520,662	Pounds of Coal Burned.....46,994,844 For Generator House.....1,378,751 For Pumping.....45,616,093 Pounds of Coal per Million Gallons 2,025	Pounds of Dry Ash.....9,123,220	
2.....	6.46	30	5,433,280	4,380,263,470			
3.....	5.96	05	5,028,395	4,238,936,955			
6.....	6.17	03	6,135,370	4,386,789,550			
13.....	7.30	55	7,154,840	5,115,710,600			
14.....	1.20	15	Venturi Meter	120,396,628			
Total.....	31.815	58	28,395,929	22,525,617,895			

H. S. Station No. 3.

7.....	3.312	10	3,138,700	1,333,947,500	Pounds of Coal Burned.....45,084,936 For Generator House.....2,824,571 For Heating.....1,396,813 For Pumping.....40,863,552 Pounds of Coal per Million Gallons 2,626	Pounds of Dry Ash.....8,172,712	
8.....	3.553	25	3,374,100	1,433,992,500			
9.....	5.427	40	5,075,300	3,243,116,700			
10.....	5.610	00	4,821,700	3,081,066,300			
11.....	6.065	05	5,187,900	3,315,068,100			
12.....	5.753	10	4,940,700	3,157,107,300			
Total.....	2.9721	30	26,538,400	15,564,298,400			

L. S. Station No. 2.

4.....	4.729	30	Venturi Meter	5,707,150,000	Pounds of Coal Burned.....47,088,300	Pounds of Dry Ash.....7,758,760	
5.....	3.940	15		4,526,670,000	For Generator House.....6,258,616		
6.....	5.419	45		5,976,070,000	For Heating.....2,035,800		
7.....	6.975	45		8,389,000,000	For Pumping.....38,793,884		
8.....	5.570	15		6,521,120,000	Pounds of Coal per Million Gallons 980		
9.....	6.553	30		8,197,490,000	Max. 81.2 Min. 63		
Total.....	33.219	00		39,317,500,000	Elev. Wet Well.....101.8 Elev. of River.....105.0 Temp. of Water.....62° 51° 56°		

## SUMMARY, TABLE No. 51—Continued.

Station	SUMMARY					Pounds Coal per Million Gal.	Water Consumption
	Time Running	Revolutions	U. S. Gallons Water Pumped	Pounds Coal For Pumping			
High Service Nos. 1 and 2.....	31,815 58	28,595,929	22,525,617,895	45,616,093	2,026		
High Service No. 3.....	29,721 30	26,538,400	15,564,298,400	40,863,552	2,626		
Total.....	61,537 28	55,134,329	38,089,916,295	86,479,645			Maximum..... 152,665,470
Low Service No. 2.....	33,219 00		39,317,500,000	38,793,884	980		Minimum..... 73,942,740
Total.....	94,756 28		77,407,416,295	125,273,529			Average..... 104,345,075

## Pumping Expense.\*

	Coal	Repairs	Operating and Maintenance	Total
High Service Nos. 1 and 2.....	\$57,040 87	\$30,479 01	\$66,160 19	\$ 153,680 07
High Service No. 3.....	51,437 70	22,517 18	65,879 17	139,834 05
Low Service No. 2.....	51,527 82	32,785 13	41,524 80	125,837 75
Total.....	\$160,006 39	\$85,781 32	\$173,564 16	\$419,351 87

## Pumping Cost Per Million Gallons.\*

	Coal	Labor and Maintenance	Total
High Service Nos. 1 and 2.....	\$2 533	\$4 292	\$6 825
High Service No. 3.....	3 305	5 679	8 984
Low Service No. 2.....	1 310	1 890	3 200
Total Pumping Expense per Million Gallons.....			\$11 009

\* Not including expenses for heating and electric generation.

## DISTRIBUTION SECTION.

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### REPORT OF THE PRINCIPAL ASSISTANT AND ACTING ENGINEER-IN-CHARGE.

St. Louis, Mo., April 10th, 1918.

HON. EDWARD E. WALL,  
Water Commissioner.

DEAR SIR: I herewith submit the following report on the operation of the Distribution Section for the year ending March 31st, 1918:

#### PIPE EXTENSION.

The practice of installing all lines of pipe with street service forces was continued during the year. It effected not only a saving of time but established a thorough and efficient working organization. A total of 35,917 lineal feet of water pipe was installed and the resultant effect showed fewer complaints from consumers as to interrupted service and far more satisfactory results as to maintenance of excavations.

The 36-inch lock-bar riveted steel main, 26,669 feet in length, was completed in place April 14th, 1917, and after street service forces effected some necessary changes in the pipe system, in the immediate vicinity of Reservoir Park, the line was put in service on July 30th, 1917. The total cost of this line was \$259,345.10, or \$9.72 per lineal foot. Sterilization of this trunk line was effected by means of hypochlorite of lime, the work being done under the personal supervision of a laboratory assistant. Flow tests showed the delivery of this line to be approximately one million gallons per hour.

This feed main is a special feature of the St. Louis pipe system and is used as a composite carrier for either high or low pressure as the occasion requires. The change in this trunk line from high to low service distribution is effected by the operation of a few hand-operated valves in front of Engine House No. 2, and two hydraulically-operated valves at the terminus of the steel main in Reservoir Park, where it is breeched into both systems by means of a "Y" connection. The hand-operated valves in front of No. 2 house will shortly be replaced with hydraulic valves on new manifold, now being installed, and the change in feed service will then be made in fifteen minutes, whereas it now requires two hours.



OLD STREET SERVICE STATION AT 111 CHESTNUT STREET.

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In times of emergency or excessive draught, this steel main will serve as a reserve or reinforcement for either system. During the night it will act as a reserve on the low system to replenish Compton Reservoir in times of extreme draught. At times when that particular portion of the high system, located between Magnolia Avenue and Meramec Street, Jefferson Avenue and Grand Avenue, is in need of reinforcement, this main will serve as a direct carrier to this locality.

For several years in this particular locality a noticeable drop in pressure prevails during the warm weather, due to excessive draught. and the department hopes to overcome this by means of this carrier. Preliminary tests show an average increase of eight pounds pressure.

Many lines of pipe and connections, which necessitated immediate installation and which do not show in the tables, were installed by the Water Division for the War Department or for units directly under the jurisdiction of the War Department, with quickest possible dispatch. Chief among these might be mentioned a small distributing system supplying the Second Engineers Encampment, just south of the Chain of Rocks; a 6-inch fire line 934 feet long with adequate fire hydrants in the United States Arsenal, between Utah and Arsenal Streets; an 8-inch cast iron line 350 feet long, supplying the Government's new warehouse, for fire protection and general use. In addition to the installation of these lines, the street service set three hydrants at the roadway level of the Compton Avenue viaduct, so that fires in the Terminal Railroad Yards can be effectively handled by the Fire Department. These and various other connections, mostly for private use, in conjunction with pipe line extensions, kept the department working at maximum speed, and as a shortage of labor existed the division exceeded expectations in its accomplishment.

### MAINTENANCE.

The street service forces, in addition to the actual extension work and Government installations, adjusted 17,649 feet of water main to revised street grade in advance of permanent street improvement. Not only were street service forces required in this adjustment, but co-operative help from the meter and tap branch was needed. Material and labor furnished by the meter and tap branch in this readjustment to revised grade amounted to approximately 25 cents per lineal foot, or \$4,375.00. Much of this expense can be eliminated by better co-operation between the Street and Water Divisions; and with this in view the Street Division has been asked to notify the Water Division as to proposed improvements at least six months in advance. The adjustment of

hydrants, valve-boxes and other appurtenances to line and grade during the prosecution of street improvement was continued with resultant good to both Street and Water Divisions. Fortunately, the department was not called upon to attend any serious breaks in large mains. The only break of consequence occurred at the Terminal Belt Line on Broadway just south of Bellefontaine Cemetery, where a 36-inch cast iron main crosses a street railway bridge supported on steel framework. Due to settlement of this supporting structure, a 36-inch curve pulled at the joint. Upon discovery of this fact, the pipe was rearranged for a distance of some thirty feet by burning out the joints and respacing pipe at an adjacent sleeve. The position and location of this main made the work tediously slow and more time was expended in the repair than would have ordinarily been required.

The main source of trouble to the Street Service Division during the year, especially during the extreme cold weather, was the failure of the smaller sized mains, principally those 3, 4 and 6 inches in diameter. An aggregate of sixty-six breaks occurred, twenty-seven of these being on 3 and 4-inch mains in the alleys of the commercial district. It has been the practice of the department to discontinue alley pipes when all consumers have abandoned service from this source; but the department will strive to have the remaining service changed over to the nearest street main during the ensuing year, obviating the necessity of attendance on these frequent breaks.

The policy of valve examination has been continued. New valves have been inserted when the installation effected a better confinement of shut. Replacement of old-style hydrants by those of self-draining type during the year shows a total installation of 221 hydrants, there now being in operation 3,804 of the self-draining type.

The annual revenue from sprinkling hydrant rental amounted to \$8,624.54. Some changes in the design of these hydrants have been made, which minimizes the danger of break and water waste, consequently lessening the cost of maintenance.

### WATER MAIN CLEANING.

On September 26th, 1917, a contract was let for the cleaning of approximately fifty miles of water mains, ranging in size from 6 to 20 inches in diameter. At the present time about 54 per cent of this contract has been completed, 153,900 feet having been cleaned up to April 1st, 1918.

Due to prompt house-to-house inspections, before and after cleaning, consumers were inconvenienced but slightly from choked service



NEW STREET SERVICE STATION AT 111 CHESTNUT STREET

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connections. The incrustation removed in the cleaning process is composed of lime, silt and mud mixed with an iron deposit which adheres firmly to sides of pipe. In addition to this natural incrustation, rocks, sticks and sundry other articles were removed during the cleaning process. A fair estimate of the amount of deposit removed can be gained from the following: 150,500 lineal feet of various sizes cleaned, shows an aggregate dry volume of 7,187 cubic feet, amounting to 143 wagon loads, or a little over four wagon loads per mile cleaned. The cleaning has been of vast benefit to the department in increased water volume and should be continued until all mains 6 to 20 inches in diameter in service previous to 1906 have been cleaned.

Elsewhere in report tabulated figures showing incrustation removed and volumetric increase of supply have been prepared.

### BUILDINGS, GROUNDS AND EQUIPMENT.

A new street service station has been erected by contract at No. 111 Chestnut Street, at a cost of \$11,209.33.

The building is very modern and well adapted to the needs of a service station.

A valve house, both ornamental and protective, over two hydraulic valves in Compton Reservoir grounds was designed and constructed by the department at a cost of \$2,034.84.

Minor but necessary repairs were made at five other service stations.

A new 3½-ton Federal truck, purchased during the year, has aided materially in the work of the distribution service. The 5-ton Alco truck has been overhauled at small cost, and with the exercise of carefulness should be of service for the ensuing two years. The department has practically made all repairs on the department automobiles at minimum cost and with more dispatch than previously obtained at the central garage. Operating cost per car per month, exclusive of chauffeur's salary, which must be termed a fixed expense, and labor expended in making repairs has been tabulated in a special table. The costs were based on prevailing prices, such as gasoline at 20 cents per gallon, lubricating oil at 30 cents per gallon and prevailing tire prices, based on a guaranteed mileage of from 4,000 to 7,500 miles. The average time for any one car being out of service on account of repairs has been four hours. Several new Form-a-Trucks have been added, the department now maintaining six auto trucks, consisting of one 5-ton Alco, one 3½-ton Federal, one 2-ton Dorris, one 1-ton Dorris, and two 1-ton Fords, or an aggregate tonnage of thirteen. In addition to the

auto equipment the division still maintains thirty-one wagons for general use.

### DRAFTING.

The routine method of posting all new work or changes in the system on the sectional maps, plat books and card index system has been carefully continued. A 200-foot scale, sectional panel map of the entire city, showing mains, hydrants, valves, etc., has been posted to date for the convenience of the night forces at the principal Street Service Station at Walnut Street. The pitometric, insurance, pressure, sprinkling hydrant, drinking hydrant and fire hydrant maps have been correctly posted. The numbering of separation valves has been continued and in addition to the indexing of same, the maps have been posted with the valve numbers.

Isometric perspective views have been prepared of a manifold to replace the present antiquated arrangement of by-passes and valves at Engine House No. 2; and preliminary drawings have been made for a similar purpose for Engine House No. 1, both at Bissell's Point.

Various tools and appliances have been designed and drawings made to facilitate the work of the section.

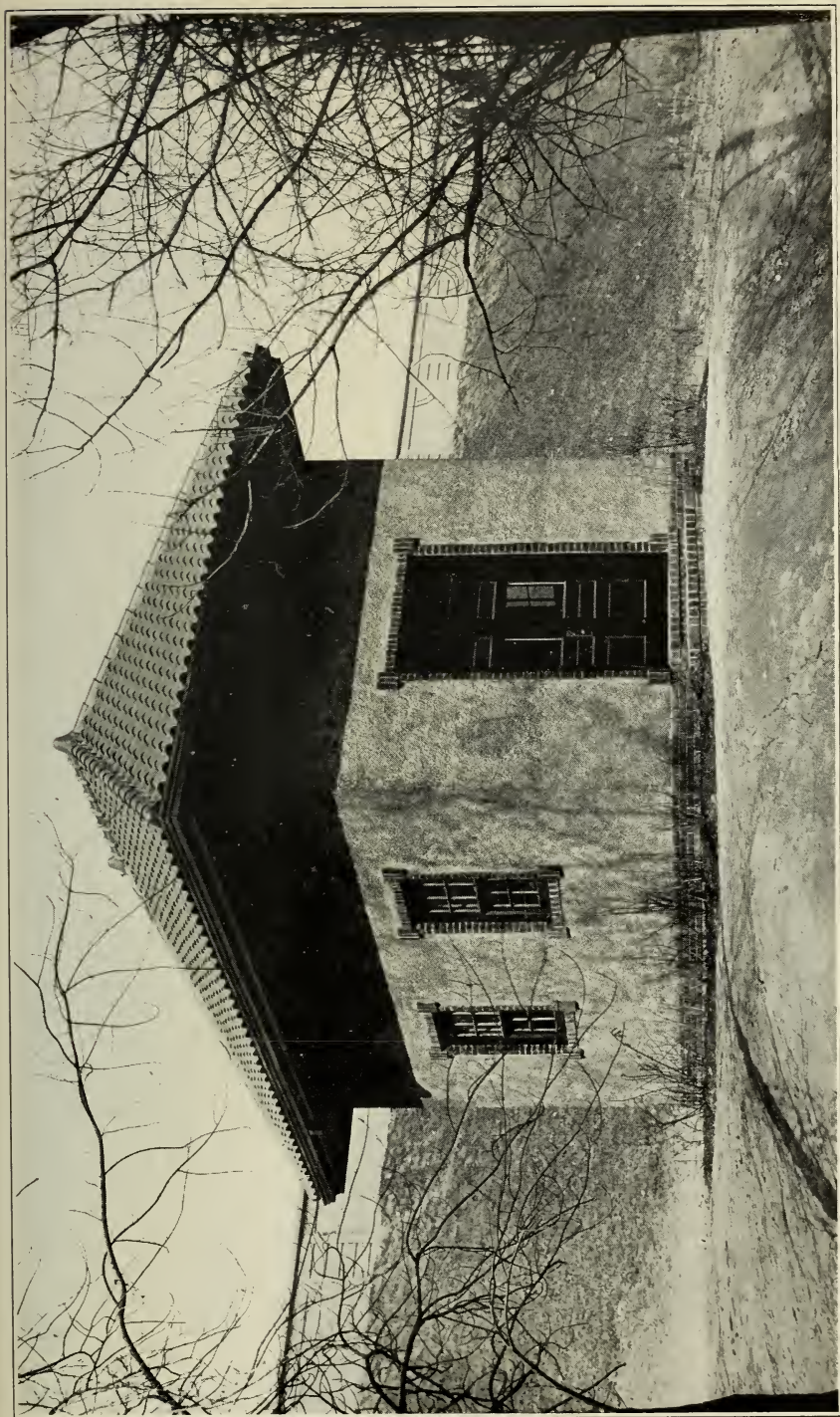
All routine duties have been conscientiously and politely fulfilled, thus promoting co-ordination between the various City Departments and the public.

### HYDRAULIC DATA.

Tests were conducted to ascertain head lost through check valves on Pump Mains 4 and 5 on Bissell Street, just west of Broadway, by means of gauges and pitometer.

Pump Main No. 4 showed an average velocity of 4.52 feet per second, with 0.43 feet loss of head. Pump Main No. 5 showed an average velocity of 5 feet per second, with 0.49 feet loss of head. Both check valves were found to be in good working order.

Flow tests by pitometer were made on the 20-inch Bulwer Avenue main, between Carrie Avenue and Newman Avenue. Under ordinary conditions an average velocity of 0.54 feet per second was recorded. The highest velocity obtained was 1.31 feet per second, and this occurred when a locomotive drew water from a stand-pipe connected to this 20-inch main. Few connections are taken off this main, and as all fire hydrants on this 2,250-foot stretch of main have been removed on account of the creation of a railroad yard, the line is practically useless as a carrier and could be removed.



VALVE HOUSE, COMPTON RESERVOIR—OVER TWO 36-INCH HYDRAULIC VALVES.

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Pressure records were collected from the permanent gauge stations and filled. Comparative pressure readings at these stations during the time of heaviest draught are tabulated in a special table. These show an average pressure increase over corresponding period of previous year on the low service during the heavy summer draught from two to six pounds, and from one to five pounds' increase during the winter draught. Pressure observations were taken by recording gauge method on the low and high system as a check on office data and for information relative to extension work and the improvement of pressure conditions where necessary. Careful investigation was made of all pressure and service complaints from consumers. Conditions were remedied when department was at fault and recommendations were made when improvement necessitated private work.

The Distribution Section added the latest type Cole pitometer recorder and a new wireless pipe locator to the hydraulic equipment.

An accuracy test with the Cole instrument was made on the new 36-inch steel main for high and low velocities of flow. Counter readings taken from Venturi meter chart in Engine House No. 2 showed an average of 4 per cent error in the instrument. No doubt this percentage of error is a little high, as the average pipe co-efficient for the steel main was 0.85, this being small due to the fact that traverses could not be made at right angles to each other. Satisfactory results have been obtained from the use of both of these new instruments.

### METER AND TAP BRANCH.

Some necessary changes were made on the large meter-testing device, improving its accuracy in testing large meters.

A concrete weir has been installed to act as check in measuring the flow from meter-testing tank and this necessary device will be placed in operation as soon as a mechanical recording device now designed is put in weir chamber.

During the year 1,448 meters were tested. Five thousand two hundred and thirteen meters were inspected and repaired, this being 61.2 per cent of the total number in service. As 182 metered connections were added during the year, there are now in service 8,508 meters, being 7.2 per cent of the total services.

Considerable plumbing work was done by this branch in the adjustment of water mains to revised street grades, in advance of permanent improvement. An approximation of the work can be readily ascertained when it required ninety-eight full days' plumber help, being 31 per cent of the full working year.

An average cost per lineal foot of pipe lowered for material and labor furnished by the Meter and Tap Branch is 25 cents.

Where improvement is made in localities where the settlement is dense and the street thoroughly built up the cost runs as high as 37 cents per lineal foot. In the improvement of Adkins Avenue, from Taft to Delor, 995 feet of 6" water main were lowered, which necessitated the use of 464 feet of  $\frac{5}{8}$ " extra strong lead service pipe to repair the damages to service connections by grader in the excavation.

As there were but thirty-five services to be repaired, it required slightly over 13 feet of lead pipe for each connection. As the average length of lead service connections on streets 50 feet wide are 25 feet, it was requisite that the Water Division replace approximately 50 per cent of each connection pipe which was ruthlessly cut and carried off in grading operation.

Cost data on lowering mains per lineal foot, exclusive of labor and material furnished by Meter and Tap Branch, is as follows:

	6"	12"	20"	All sizes
Laying .....	.428	.48	1.247	.433
Lowering .....	.499	.585	1.828	.556

In laying, hauling cost and repaving repairs at 40 cents per square foot are included. In lowering no repaving costs are assessed, as no lowering is ever made after improvement.

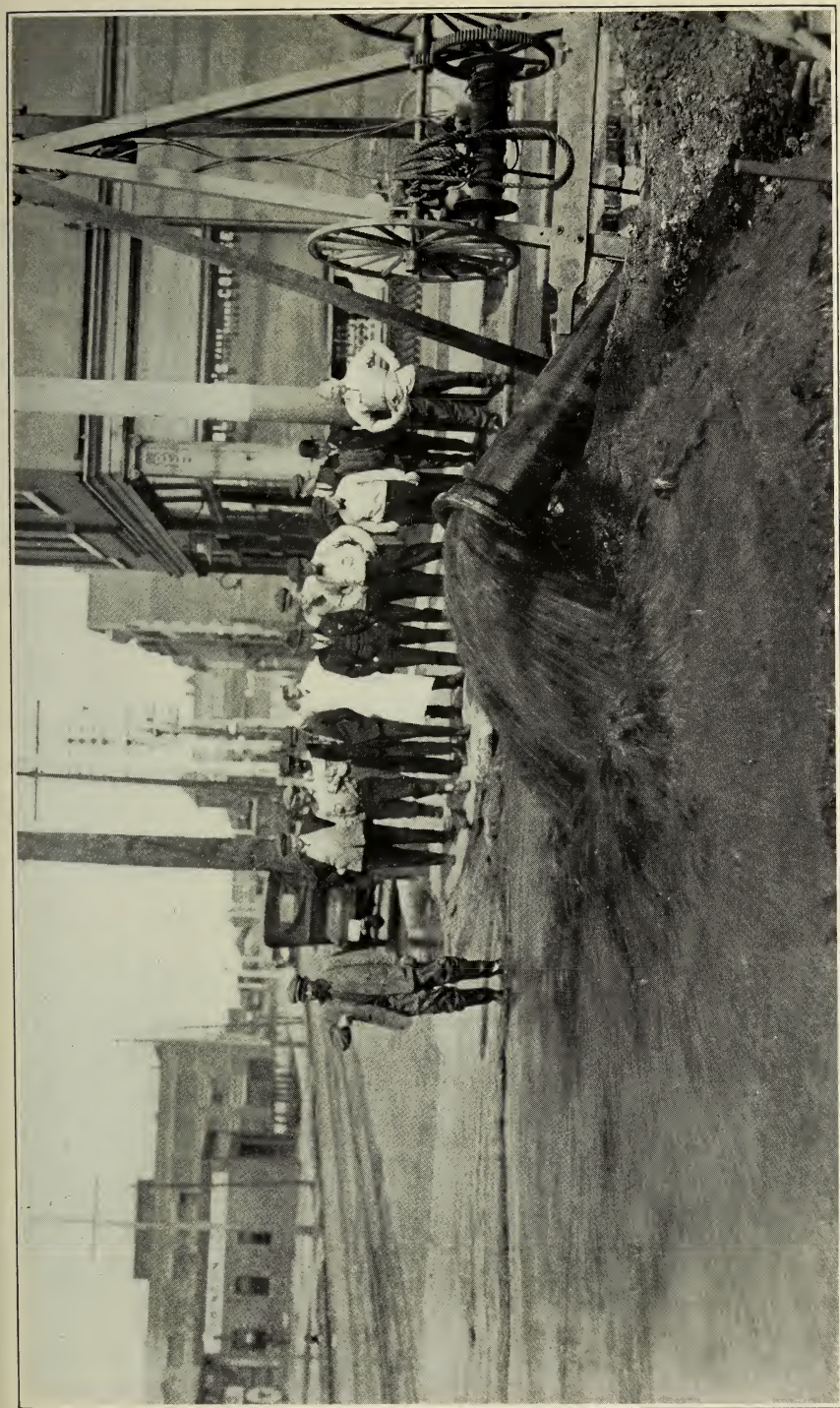
When an additional 25 cents per lineal foot for labor and material furnished by the Meter and Tap Branch is assessed against lowering, this work becomes excessive in cost to the division and calls for immediate remedial measures.

It is the intention during the ensuing year to initiate several methods which will improve the method of installation and repairs.

One Form-a-Truck motor vehicle was added to the rolling stock, and the other motor equipment was kept in first class repair.

### INSPECTION BRANCH.

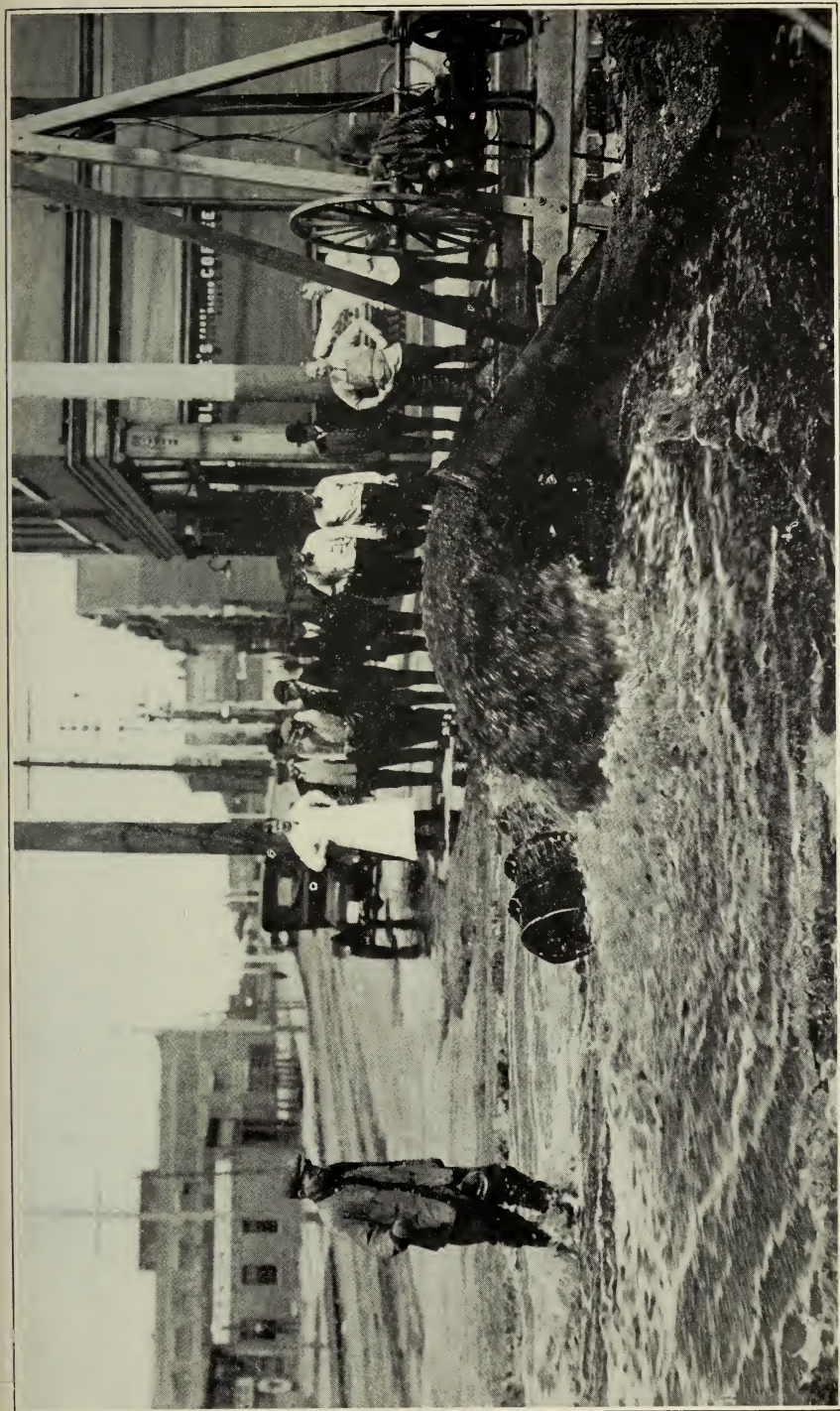
The usual house inspection has been continued, a total of 137,191 inspections having been made, which is 43,063 in excess of inspections for the previous year. Of these 137,000 inspections, 6.1 per cent or 8,393 services were found to be defective and upon notice to repair all but 461 were promptly attended and these few were shut.



CLEANING 20-INCH WATER PIPE, MCREE AVE., FROM GRAND AVE. TO TOWER GROVE AVE.

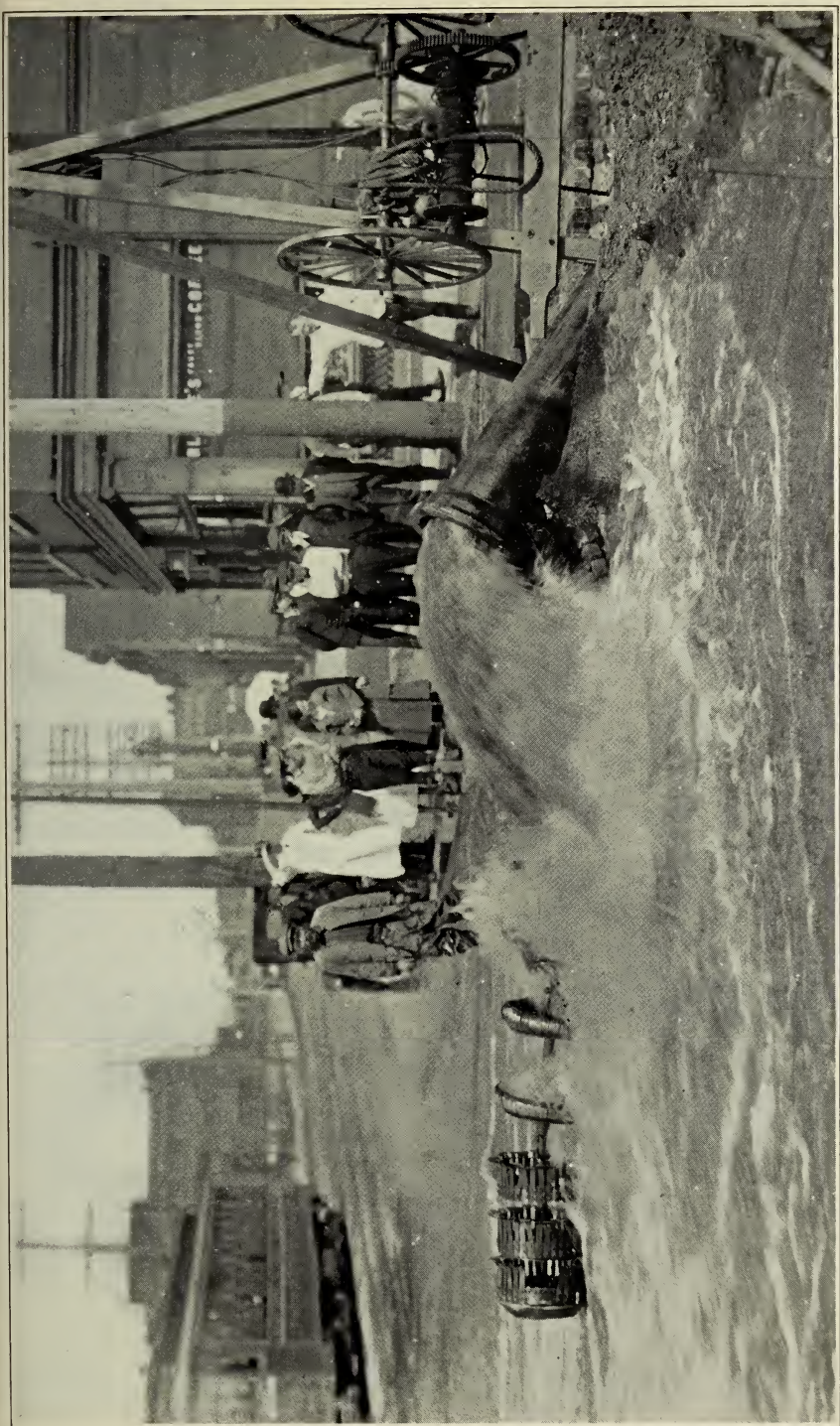
(Discharge at Tower Grove Ave.)  
1. While Cleaning Machine is Moving Through Main.





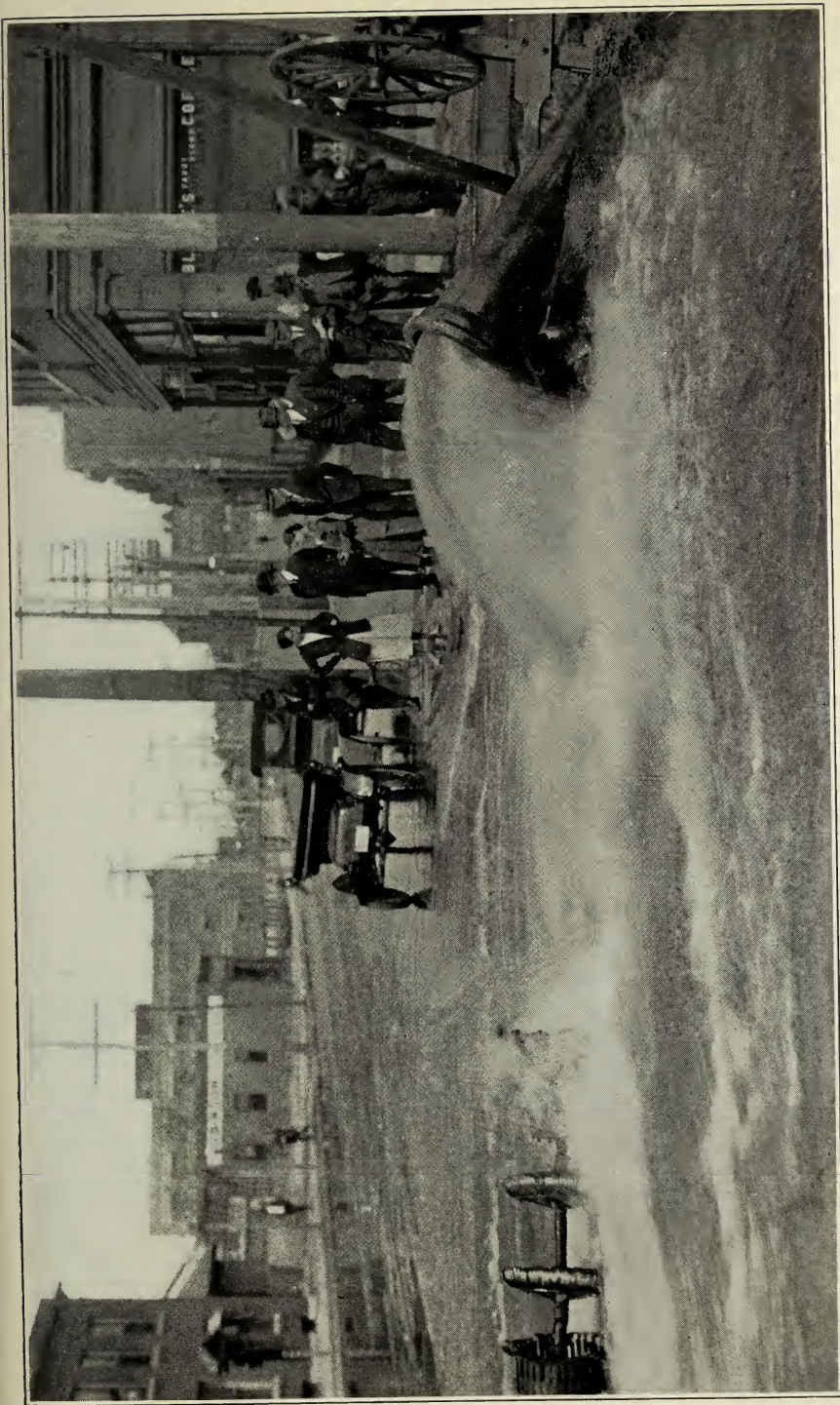
CLEANING 20-INCH WATER PIPE.  
2. Just as Machine is Ejected from Main.

THE LIBRARY  
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CLEANING 20-INCH WATER PIPE.  
3. As Water is Clearing Up.

THE LIBRARY  
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CLEANING 20-INCH WATER PIPE.  
4. Clear Water Coming Through Clean Main.

THE LIBRARY  
OF THE  
UNIVERSITY OF ILLINOIS

This inspection, coupled with the various other duties assumed by this branch under authority of Ordinance No. 28.526, has kept the work going at a rapid pace.

In addition to these routine duties, the Inspection Branch was called upon for assistance in making special investigations, on witnessing the destruction of taps and examination of services used exclusively for fire protection. In the latter examination many of the valves and hydrants were resealed. Due to the prompt report of broken seals by the Fire Prevention Bureau much help was rendered the Inspection Branch.

### NEW WORK.

Shortage of labor and excessive cost of materials practically prohibits any extensive new work.

It is the intention of the division to prosecute to completion work which has been contemplated for some time. Material for these installations has been obtained and the actual work well begun during the month of May.

The construction-in-place of manifolds in front of Engine House No. 2 at Bissell's Point and the readjustment of distributing feed mains in connection therewith is the principal large single piece of work of the section for the ensuing year.

A new 72-inch cast iron water main, with bell and spigot ends, to be installed at the Chain of Rocks as a discharge pipe from Low Service Turbine No. 10 to delivery well, will be laid by the distribution forces.

Sufficient cast iron water pipe and necessary appurtenances were purchased during the year to provide for possible extensions to the pipe system, so the division will repair and overhaul, rather than extend during the ensuing year.

Tabulations showing details of work for fiscal year ending March 31st, 1918, are herewith appended.

Yours respectfully,

WILLIAM A. FOLEY,

Principal Assistant and Acting Engineer-in-Charge.  
Distribution Section.

TABLE No. 52.

**WORK DONE ON PIPE SYSTEM BY DISTRIBUTION FORCE,  
APRIL 1st, 1917, TO APRIL 1st, 1918.**

SIZE	Extensions and Changes	Pipe Laid Private Connections and Private Fire Lines	Pipe Relaid and Adjusted
3-inch.....	347 ft.	1,056 ft.	.....
4-inch.....	279 ft.	541 ft.	72 ft.
6-inch.....	25,144 ft.	2,812 ft.	14,170 ft.
8-inch.....	100 ft.	276 ft.	240 ft.
12-inch.....	7,536 ft.	.....	1,585 ft.
15-inch.....	.....	.....	960 ft.
20-inch.....	.....	.....	610 ft.
30-inch.....	396 ft.	396 ft.	12 ft.
36-inch.....	.....	495 ft.	.....
	34,207 ft.	4,685 ft.	17,649 ft.

TABLE No. 53.

**WORK DONE ON FIRE HYDRANTS, STOP VALVES AND  
SPRINKLING HYDRANTS FROM APRIL 1st, 1917,  
TO APRIL 1st, 1918.**

	Fire Hydrants	Stop Valves	Sprinkling Hydrants	Meter Boxes
Cleaned, oiled and packed in place.....	29,878	25,962	0	.....
Repaired on City account.....	201	17	5	.....
Repaired on private account.....	0	1	0	.....
Moved.....	142	0	15	.....
Taken out of service.....	27	17	5	.....
Replaced.....	871	23	108 1/4	.....
Set new.....	112	199	4	0
Boxes set or repaired, wood.....	1	11	0	1
Boxes set or repaired, concrete.....	84	420	0	241
Boxes set or repaired, iron.....	0	0	55	0
Boxes set or repaired, brick.....	8	33	0	38



TABLE No. 55. WATER PIPE LAID FROM APRIL 1st, 1917, TO APRIL 1st, 1918.

STREET	FROM	TO	48 Inch	36 Inch	30 Inch	20 Inch	15 Inch	12 Inch	6 Inch	4 Inch	3 Inch	Number of Fire Hydrants	Date Water Turned on
Alabama Ave.	Liberty St.	Delor St.							432			1	July 2, 1917
Alcott Ave.	Penrose St.	North.							468			2	March 12, 1918
Alcott Ave.	Theodore Ave.	Thelia Ave.							865			3	March 30, 1918
Bellevue Ave.	Beacon Ave.	Genevieve Ave.						528	210			2	May 26, 1917
Bircher St.	S. of Adelaide Ave.	N. of College Ave.							204				August 16, 1917
Bircher St.	Arlington Ave.	Beacon Ave.				240		912	60			1	September 4, 1917
Bissell's Point Grounds.													
Christy Ave.	Richelberger St.	Wilcox Ave.	111	25					672			2	April 7, 1917
Cora Ave.	Exchington Ave.	Ashland Ave.							384			2	April 18, 1917
Cologne Ave.	Eichelberger St.	North.							732			2	April 20, 1917
Compton Reservoir				384									May 23, 1917
Chain of Rocks.	River View Drive.	Eastward							1,572			5	June 23, 1917
Courtois St.	Broadway	Michigan Ave.						1 020	36			2	August 4, 1917
Cooper	Pattison Ave.	Northrup Ave.							348			1	August 18, 1917
Dresden Ave.	Eichelberger St.	North.							768			2	August 14, 1917
De Soto Ave.	Emily St.	Twentieth St.							396				May 14, 1917
Emilie Ave.	W. of Ellendale Ave.	Mo. Pac. Ry.							246			1	August 2, 1917
Frieda Ave.	Morgan Ford Road	Gravois Ave.							636			2	May 14, 1917
Fair Ave.	Ashland Ave.	Natural Bridge Ave.							888			2	June 2, 1917
Frisco Ave.	Fyler Ave.	Scanlan Ave.						1,044	48		192	3	July 17, 1917
Fort Bellefontaine.	Farms	North.							1,632			2	March 7, 1918
Grover Pl.	North Market St.	Gravois Ave.							372			2	May 18, 1917
Gertrude Ave.	Morgan Ford Rd.	West.							804			3	May 26, 1917
Geyer Ave.	Louisiana Ave.	Gravois Ave.		396									May 22, 1917
Gustine Ave.	Gravois Ave.	Chippewa St.							840			2	September 29, 1917
Hydraulic Ave.	Union Ave.	Geraldine Ave.							960			3	July 16, 1917
Harney Ave.	Arlington Ave.	Claxton Ave.							360			2	July 16, 1917
Harford St.	Louisiana Ave.	Compton Ave.							696			1	July 25, 1917
Kennery Ave.	Hamilton Ave.	Goodfellow Ave.							1,008			2	August 7, 1917
Kennery Ave.	Hodiamont Ave.	City Limits.							136			2	June 15, 1917
Lafayette Ave.	Tower Grove Ave.	Newstead Ave.							576			1	June 18, 1917
Maffitt Ave.	Euclid Ave.	Kingshighway							876	883		3	June 8, 1917
Macklind Ave.	Shaw Ave.	Daggett Ave.							444			2	June 7, 1917
Newstead Ave.	De Tony St.	Shaw Ave.							408			1	November 13, 1917
Neosho St.	Ridgewood Ave.	Christy Ave.							856			3	November 20, 1917
Ohio Ave.	Gasconade St.	North.							270			2	March 16, 1918
Olive Street Road.	Hodiamont Ave.	City Limits.							660			2	June 8, 1917
Oregon Ave.	Dakota St.	South.							312				August 1, 1917
Prange Ave.	Thrush Ave.	Wren Ave.							780			2	December 24, 1917
Partridge Ave.	Amelia Ave.	Lillian Ave.							1,152			4	August 1, 1917
Robert Ave.	Sharp Ave.	East.							500			2	August 23, 1917
Spring Drive.	River View Drive	City Limits.							720			2	July 20, 1917
St. Ferdinand Pl.	Prairie Ave.	East.							312				October 11, 1917
Thelia Ave.	Emerson Ave.	Arlington Ave.							900			1	June 9, 1917
Theodore Ave.	Davison Ave.	Thrush Ave.							320			1	August 14, 1917
Union Ave.	Natural Bridge Ave.	Bircher St.						3,948	312			5	January 2, 1918
Total.			495.25	396	240			7,452	25,147	883	192	80	



TABLE No. 57. PRIVATE CONNECTIONS PUT IN FROM APRIL 1st, 1917, TO APRIL 1st, 1918.

STREET	BETWEEN	AND	SIZE	3-in.	4-in.	6-in.	8-in.	Date	OWNER	USED FOR
Berlin	DeBaliviere	Union	3"	1				April 2, 1917	University Investment Co.	General Supply.
Berlin	DeBaliviere	Union	3"	1				April 6, 1917	John F. Brooks	General Supply.
Chouteau	Private Road	Tiffany	6"					April 7, 1917	St. Louis-San Francisco R. R.	Locomotive Crane
Broadway	Franklin	Wash.	6"			1		April 11, 1917	Hart Estate, F. H. Sample, Trustee	Fire Protection
Baldwin	Benton	Montgomery	3"	1				April 11, 1917	Warner-Jenkinson Manufacturing Co.	General Supply
Locust	Ninth	Tenth	6"			1		April 16, 1917	Martin Monti	Fire Protection
Shaw	Tower Grove	Vandeventer	4"					April 19, 1917	Missouri Botanical Garden	General Supply
Twelfth	Olive	Locust	4"		1			April 20, 1917	Pulitzer Publishing Co.	General Supply
Washington	Fifteenth	Sixteenth	6"					April 25, 1917	James C. Crowder	Fire Protection
Third	Cedar	Plum	6"			1		May 9, 1917	John T. Milliken Construction Co.	Fire Protection
Plum	Second	Third	6"			1		May 10, 1917	John T. Milliken Construction Co.	Fire Protection
Plum	Second	Third	6"			1		May 10, 1917	John T. Milliken Construction Co.	Fire Protection
Pine	Twenty-first	Twenty-second	6"			1		May 23, 1917	Frank A. Ruf	Fire Protection
Jefferson	Pestalozzi	Lynch	4"		1			May 24, 1917	Rice-Stix Dry Goods Co.	General Supply
Pine	Jefferson	Beaumont	3"	1				June 1, 1917	Paris Medicine Co.	General Supply
*Bircher	Beacon	Davison	6"			2	1	June 1, 1917	The Pullman Co.	Fire Protection
Arsenal	Beacon	Davison	6"			2	1	June 1, 1917	The Pullman Co.	General Supply
Sullivan	Minnesota	Michigan	3"					July 10, 1917	Gilbert Chapman	General Supply
Grand	Garrison	Grand	4"					July 12, 1917	St. Louis Y. M. C. A.	General Supply
Pine	Washington	Delmar	6"		1			July 21, 1917	University Club Building Co.	General Supply
Chouteau	Ewing	Lefingwell	4"		1			July 31, 1917	St. Louis Y. M. C. A.	General Supply
Park	Spring	Pacific	6"			1		Aug. 9, 1917	Independent Packing Co.	Fire Protection
Broadway	Doltman	Grattan	3"	1				Aug. 11, 1917	Schultz Realty Co.	General Supply
Broadway	Shenandoah	Ann	3"	1				Aug. 14, 1917	Lulu Mueller	General Supply
Broadway	Shenandoah	Ann	4"	1				Aug. 14, 1917	Lulu Mueller	General Supply
Twenty-second	Scott	Broadway	4"		1			Aug. 18, 1917	Meyer Bros. Drug Co.	Fire Protection
Adelaide	Bulwer	Harris	6"			1		Aug. 22, 1917	Missouri Paper Stock Co.	Fire Protection
Adelaide	Bulwer	Harris	6"			1		Aug. 22, 1917	Cooper-Carriage W. W. Co.	Fire Protection
Washington	Broadway	Second	6"			1		Aug. 24, 1917	Cooper-Carriage W. W. Co.	Fire Protection
*Arsenal	Ninth	Thirteenth	6"				1	Sept. 8, 1917	Colonial Realty Co.	Fire Protection
Maiden Lane	Nineteenth	Thirtieth	6"					Sept. 14, 1917	Anheuser-Busch Brewing Co.	General Supply
Alley East of Sixth St.	Chestnut	Pine	4"		1			Sept. 22, 1917	Columbia Box Co.	Fire Protection
Morgan Ford	Oleatha	Tyler	3"	1				Sept. 22, 1917	Emma Roe Titman	General Supply
Folsom	Thurman	Klemm	3"	1				Sept. 26, 1917	Missouri Pacific Ry. Co.	General Supply
St. Charles	Ninth	Tenth	4"		1			Oct. 4, 1917	Liggett & Meyers Tobacco Co.	General Supply
Vandeventer	McRee	Blaine	3"	1				Oct. 18, 1917	Union Electric Co.	General Supply
Kingshighway	Manchester	McRee	4"		1			Nov. 15, 1917	American Car Co.	General Supply
									Northwestern Bank	General Supply

\* Eight-inch valve connections reduced to six-inch line.

TABLE No. 57. PRIVATE CONNECTIONS PUT IN FROM APRIL 1st, 1917, TO APRIL 1st, 1918—Continued.

STREET	BETWEEN	AND	SIZE	3-in.	4-in.	6-in.	8-in.	Date	OWNER	USED FOR
Vista.....	Tiffany.....	Frisco R. R.....	3"	1	.....	.....	.....	Nov. 19, 1917	Northwestern Bank.....	General Supply
Twenty-first.....	Bremen.....	Farrar.....	4"	.....	.....	.....	.....	Nov. 30, 1917	Krey Packing Co.....	General Supply
Mallinckrodt.....	Hall.....	Wharf.....	3"	1	.....	.....	.....	Dec. 6, 1917	National Ammonia Co.....	General Supply
U. S. Arsenal.....	Utah.....	Arsenal.....	6"	.....	2	.....	.....	Dec. 6, 1917	U. S. Government.....	Fire Protection
Seventeenth.....	Locust.....	St. Charles.....	6"	.....	1	.....	.....	Dec. 27, 1917	Seventeenth Street R. Co.....	Fire Protection
Arsenal.....	Broadway.....	Seventh.....	6"	.....	1	.....	.....	Jan. 8, 1918	Anheuser-Busch Brewing Co.....	Fire Protection
U. S. Arsenal.....	Utah.....	Arsenal.....	8"	.....	.....	.....	1	Feb. 4, 1918	U. S. Government.....	Fire Protection
Newman.....	Bulwer.....	Prescott.....	3"	1	.....	.....	.....	Feb. 8, 1918	Curtis Manufacturing Co.....	Locomotive Crane
*Clark.....	Idaho.....	Ninth.....	6"	.....	.....	.....	1	Feb. 20, 1918	Washington University Cup. Station.....	Fire Protection
Poepping.....	Warne.....	Alaska.....	2"	1	.....	.....	.....	Feb. 28, 1918	Provident Chemical Works.....	General Supply
Carci.....	Seventeenth.....	Mary.....	6"	.....	1	.....	.....	Feb. 13, 1918	Dazey Churn Manufacturing Co.....	Fire Protection
St. Charles.....	St. Charles.....	Eighteenth.....	3"	1	.....	.....	.....	Mar. 20, 1918	Marquette Hotel.....	General Supply
Twenty-second.....	.....	Washington.....	6"	.....	1	.....	.....	Mar. 28, 1918	Hart Estate.....	Fire Protection

\* Eight-inch valve connections reduced to six-inch line.



TABLE No. 58. CLASSIFICATION OF PAY ROLL FOR MAINTENANCE OF DISTRIBUTION SECTION,  
STREET SERVICE BRANCH, 1917-1918—Continued.

	April	May	June	July	August	September	October	November	December	January	February	March	Total
Monthly Men Off Duty.....	\$ 514.97	\$ 431.44	\$ 161.64	\$ 251.30	\$ 247.00	\$ 285.04	\$ 247.89	\$ 179.90	\$ 412.25	\$ 487.63	\$ 544.25	\$ 285.28	\$ 4,057.59
Public Drinking Fountains.....	33.42	30.25	62.88	40.00	34.97	62.94	31.03	32.62	30.62	19.36	22.45	34.75	435.29
Abandoned Taps.....	48.26	64.19	98.87	89.49	56.70	37.13	68.03	95.84	51.18	12.90	262.90	190.15	1,075.64
Foundry and Pipe Laying Inspection	187.50	300.00	276.00	100.00	100.00	200.00	400.00	300.00	465.00	490.00	506.80	565.00	3,890.30
Industrial School.....													
Board of Public Service.....													
Meter and Tap Branch.....	633.92	280.64	212.98	259.35	258.91	278.92	211.40	300.64	156.04	71.95	126.17	325.45	3,116.37
Pitometer Work.....	75.00												75.00
48" Meter at Chain of Rocks.....													
Leak Inspection.....	302.58	191.75	260.36	292.66	392.03	743.82	230.00	234.93	308.31	357.75	668.45	439.90	4,528.54
Supply and Purifying Section.....	578.60	63.96	63.00	66.55	88.33	202.50	985.78	834.72	342.10	1,165.48	200.84	286.40	4,880.26
Relaying Pipe.....	819.46	7.45								412.81	13.65		1,253.37
Vacation Annual.....			955.65	1,110.14	650.00	190.19	55.00		33.96				2,960.98
City Hall Power Plant.....							7.60		144.00				41.56
Pipe Yard Garage.....								256.40		325.39	220.99	300.47	1,247.25
Totals.....	\$18,969.40	\$20,000.12	\$20,716.41	\$20,820.04	\$20,101.56	\$18,773.46	\$19,038.98	\$19,007.24	\$17,851.15	\$17,609.42	\$17,657.67	\$18,909.62	\$229,455.07

TABLE No. 59. SHOWING THE GROWTH OF THE DISTRIBUTION SECTION SINCE THE ADOPTION OF THE SCHEME AND CHARTER.

Year Ending March 31st	Miles of Water Pipe in Service	Number of Fire Hydrants	Number of Private Hydrants in Service	Number of Stop Valves in Service	Number of Private Stop Valves in Service	Number of Check Valves in Service	Number of Blow-off Valves in Service	Number of Man- holes	Number of Air Taps	Number of Taps in Service	Number of Meters in Service	Number of U. S. Gallons of Water Pumped into the City
1881.....	212	1,842	14	1,742	279	4	36	14	31	20,204	573	9,857,957,000
1882.....	225	1,965	15	1,912	316	4	36	14	31	21,745	905	9,852,430,000
1883.....	234	2,108	15	2,012	344	4	37	14	31	23,648	1,228	10,396,930,000
1884.....	238	2,163	17	2,068	372	6	42	16	31	25,321	1,522	9,542,471,000
1885.....	257	2,459	17	2,247	295	7	43	16	32	27,437	1,811	9,412,291,000
1886.....	279	2,685	21	2,518	429	41	58	16	32	29,884	2,143	9,817,943,000
1887.....	295	2,922	34	2,668	454	63	54	16	35	31,794	2,376	10,877,896,000
1888.....	314	3,161	36	2,922	500	68	57	16	43	34,022	2,662	11,520,608,000
1889.....	336	3,366	36	2,991	518	70	66	18	58	36,082	2,888	11,581,771,000
1890.....	354	3,515	37	3,148	576	67	76	18	63	38,183	3,115	11,863,457,000
1891.....	373	3,715	37	3,306	634	67	76	18	66	41,331	3,399	13,144,565,000
1892.....	393	3,916	37	3,483	700	68	79	18	66	44,382	3,601	14,453,390,000
1893.....	410	4,103	48	3,613	770	68	81	18	66	47,445	3,750	16,140,476,000
1894.....	447	4,504	63	3,915	834	70	87	19	68	50,540	3,850	17,366,270,000
1895.....	462	4,690	63	4,077	869	70	90	19	66	53,354	3,979	20,030,271,000
1896.....	493	5,020	63	4,383	931	73	103	19	66	56,865	4,092	19,542,768,000
1897.....	532	5,427	64	4,776	968	73	109	19	68	59,423	4,198	18,653,013,000
1898.....	555	5,723	65	5,094	1,019	76	138	20	89	61,839	4,151	20,366,176,000
1899.....	581	6,325	65	5,704	1,055	92	156	20	89	63,851	4,161	20,800,292,000
1900.....	616	6,920	70	6,163	1,111	83	159	20	89	65,688	4,133	22,114,261,000
1901.....	638	7,325	77	6,557	1,140	80	162	20	89	67,243	4,331	22,993,668,000
1902.....	669	7,676	88	7,048	1,220	58	166	20	90	69,483	4,525	24,525,121,000
1903.....	709	8,127	94	7,409	1,293	57	167	20	92	72,005	4,635	24,183,046,000
1904.....	729	8,334	104	7,668	1,374	57	169	20	92	74,505	4,751	25,607,414,000
1905.....	747	8,524	117	7,835	1,432	57	173	20	92	77,951	4,986	28,834,318,410
1906.....	769	8,797	117	8,210	1,469	57	169	20	92	82,325	5,278	25,181,306,000
1907.....	813	9,298	117	9,598	1,539	57	169	20	93	87,734	5,426	26,681,562,820
1908.....	843	9,631	121	10,275	1,661	56	171	20	94	91,897	5,561	25,242,921,430
1909.....	870	10,080	121	10,794	1,726	55	175	20	91	100,811	6,077	25,808,561,870
1910.....	885	10,326	121	11,010	1,768	59	175	20	91	97,030	6,631	27,529,727,210
1911.....	904	10,597	127	11,320	1,868	63	177	20	91	104,093	6,934	27,786,437,860
1912.....	916	10,774	127	11,327	1,925	63	178	20	91	106,671	7,349	30,506,655,840
1913.....	947	11,103	127	11,881	1,973	64	188	20	91	109,624	7,366	29,950,899,401
1914.....	964	11,325	134	12,107	2,048	64	190	20	95	112,162	7,571	30,942,858,790
1915.....	974	11,505	135	12,366	2,127	64	191	20	96	114,309	7,747	33,968,635,120
1916.....	991.8	11,671	139	12,473	2,188	63	194	20	96	116,014	7,927	32,726,760,360
1917.....	1,002.7	11,751	139	12,622	2,248	63	211	20	96	117,284	8,326	35,664,881,910
1918.....	1,009.4	11,866	145	12,765	2,304	63	212	43	96	118,122	8,508	38,089,916,295

TABLE No. 60. WATER MAIN CLEANING, 1917-1918.

STREET	FROM	TO	Size of Main	Length Cleaned	Weight of Incrustation per Lin. Ft.	Weight of Incrustation in Tons Removed	Volume of Incrustation in Cu. Ft. (Dry)	Volume of Incrustation in Cu. Ft. (Wet)
Natural Bridge	Newstead	City Limits	20"	13,235	6.27	41.49	1,211.4	979.7
Marcus	Natural Bridge	Florissant	12"	6,246	5.00	15.62	456.0	368.8
Fair	Natural Bridge	Florissant	12"	4,088	2.68	5.45	159.1	128.7
Lee	Grand	Taylor	12"	7,655	2.92	11.18	326.4	264.0
Cook	West of Whittier	West End	6"	5,862	0.76	0.62	18.10	14.6
Finney	Spring	Newstead	6"	5,376	0.77	2.07	60.4	48.8
Fairfax	Vandeventer	Sarah	6"	1,508	0.75	0.37	13.4	10.6
Newstead	Natural Bridge	Florissant	12"	5,351	3.58	9.58	279.7	226.2
West Belle	Spring	Taylor	6"	7,304	0.82	2.99	87.3	70.6
Prairie	Natural Bridge	St. Ferdinand	12"	3,645	2.83	5.16	150.6	121.8
St. Ferdinand	Prairie	Marcus	12"	7,900	4.27	16.87	492.5	398.3
Morgan	Spring	Taylor	6"	6,147	1.07	3.29	96.1	77.6
Broadway	Bitner	De Soto	12"	14,185	2.88	20.43	596.5	482.4
Kossuth	Grand	Taylor	20"	736	28.00	10.30	300.7	243.2
Sarah	Duncan	Maffitt	6"	4,404	0.42	0.92	26.9	21.7
Kingshighway	Natural Bridge	Easton	12"	3,197	1.20	1.92	56.1	45.3
Easton	Grand	City Limits	12"	4,565	3.00	6.85	200.0	155.74
			6"	5,571	3.44	9.58	279.7	226.2
			8"	6,805	0.80	2.72	79.4	64.2
			10"	3,228	2.04	3.29	96.1	77.7
			12"	1,180	5.28	3.12	91.1	73.7
Tower Grove	Manchester	Magnolia	20"	8,605	2.73	11.75	343.1	277.4
McRee	Grand	Tower Grove	20"	5,276	9.09	23.98	700.2	566.2
Henrietta	Nebraska	Grand	20"	4,747	3.50	8.31	242.6	196.2
Nebraska	Henrietta	Park	20"	3,353	3.50	5.87	171.4	138.6
Park	Jefferson	Thurman	20"	975	3.50	1.71	49.9	40.4
Delmar	Spring	Kingshighway	12"	9,291	3.20	14.87	430.0	351.1
			6"	2,550	1.52	1.94	56.6	45.8
			8"	3,526	2.08	3.67	107.2	86.7
Totals				151,511	107.96	246.12	7,181.70	5,807.3

Average weight of 1 cubic foot incrustation, dry.

68.5

Average weight of 1 cubic foot incrustation, wet.

84.7

TABLE No. 60—Continued.  
PIPE CLEANING—Figures showing increased carrying capacity.

LOCATION	Coefficient of Pipe Before Cleaning		Coefficient of Pipe After Cleaning	% of New Pipe	% of Increase	Size of Pipe
Laclede Avenue from Grand Avenue to Kingshighway . . . . .	48	92	89	92	6 "	
Chouteau Avenue from St. Ange Avenue to Grand Avenue. . . . .	56	108	97	93	20 "	
St. Louis Avenue from Fifteenth Street to Grand Avenue. . . . .	54	100	92	85	12 "	

Coefficients of New Pipe:

6"	104
12"	109
20"	111.5

TABLE No. 61.  
PRESSURE IN POUNDS PER SQUARE INCH.

GAUGE STATION	Service	Elevation in Feet	PRESSURE IN POUNDS PER SQUARE INCH							
			July 25-31, 1916	July 25-31, 1917	July 25-31, 1916	July 25-31, 1917	Jan. 13-19, 1916	Jan. 13-19, 1917	Jan. 13-19, 1916	Jan. 13-19, 1917
			6:00 to 9:00 a. m.	3:00 to 6:00 p. m.	6:00 to 9:00 a. m.	3:00 to 6:00 p. m.	6:00 to 9:00 a. m.	3:00 to 6:00 p. m.	6:00 to 9:00 a. m.	3:00 to 6:00 p. m.
City Hall, Twelfth and Market Streets...	Low.....	55.88	46.5	48.7	44.0	46.7	47.7	49.0	47.7	48.2
Engine House No. 3, Broadway and Salena.....	Low.....	119.67	17.2	23.2	12.7	19.2	18.2	23.5	17.0	22.2
Engine House No. 35, Arsenal and Sublette.....	High.....	190.56	17.0	21.5	15.7	28.0	31.0	30.5	33.5	33.5
Engine House No. 36, Cote Brillante and Union.....	High.....	144.56	47.5	47.7	47.2	48.2	50.0	51.5	53.5	54.0
Engine House No. 17, Easton and Leonard.....	High.....	141.44	39.7	45.0	37.2	45.7	53.7	51.2	53.7	52.5
			Average Consumption, July 25-31, 1916 = 124.7 M. G. per 24 hours. Average Mean Temperature = 88° F.				Average Consumption, January 13-19, 1916 = 104.0 M. G. per 24 hours. Average Mean Temperature = 15° F.			
			Average Consumption, July 25-31, 1917 = 121.1 M. G. per 24 hours. Average Mean Temperature = 84° F.				Average Consumption, January 13-19, 1917 = 100.2 M. G. per 24 hours. Average Mean Temperature = 22° F.			

TABLE No. 62.

## DISTRIBUTION MOTOR CAR MAINTENANCE.

MAKE OF CAR	Gas	Lubri- cating Oil	Grease	Wear on Tires	Repairs and Extra Parts	Cost per Month
Ford: Average 35 miles per day; 10 miles per gallon.....	\$17.60	\$0.53	\$0.10	\$11.67	\$1.50	\$31.40
One-ton Dorris: Average 16 miles per day; 8 miles per gallon.....	10.00	.60	.25	13.22	1.25	25.32
Three-ton Federal: Average 32 miles per day; 8 miles per gallon.....	20.00	.60	.25	19.17	1.50	41.52
Five-ton Alco: Average 20 miles per day; 5 miles per gallon.....	20.00	.90	.25	23.16	1.80	46.11

TABLE No. 63.  
WORK DONE BY BLUE PRINT MACHINE, APRIL 1st, 1917, TO APRIL 1st, 1918.

DEPARTMENT	DIVISION	Blue Paper		Blue Cloth		Brown Paper		Total Number of Prints	Total Number of Square Feet
		No. of Prints	No. of sq. ft.	No. of Prints	No. of sq. ft.	No. of Prints	No. of sq. ft.		
Board of Public Service	President's Office	1,170	4,777	458	2,750	156	358	1,784	7,885
	Bridge	3,748	39,525	467	2,153	7	35	4,215	41,678
	Special Tax	68	390	2	31	7	35	77	456
	Testing Laboratory	78	191	618	4,234	9	109	78	191
	Street Design	2,827	19,895	124	525	424	950	3,454	24,238
Public Utilities	Sewer	539	2,424	124	525	424	950	1,087	3,899
	Water	1,228	8,744	76	1,173	69	217	1,373	10,134
	Rates and Service	912	6,853	19	381	227	1,274	1,158	8,508
	Lighting	4	27	18	27	1	2	4	25
	Power Plants	133	427	18	27	1	2	152	456
Streets and Sewers	Streets and Sewers	3,527	6,592	197	863	118	296	3,842	7,751
	Harbor and Wharf	11	102	102	102	11	11	102	102
Public Welfare	Parks and Recreation	2,059	12,479	42	260	26	181	2,127	12,920
	Fire and Police Telegraph	52	282	12	14	52	282	52	282
Public Safety	Building and Inspection	420	847	12	14	432	861	432	861
	Boiler Inspector								
Finance	Office of Comptroller								
City Plan Commissioner		385	2,759	18	147	70	607	473	3,513
Miscellaneous		88	380					88	380
Total		17,249	106,692	2,039	12,544	1,119	4,043	20,407	123,279

TABLE No. 64. METER STATISTICS BY YEARS.

Year Ending April 1.	Service Meters							Supply Connections				No. %
	Installed	Removed	Replaced	Condemned	Tested	Owned by City	Total	Total	Metered			
1912.....	345 4.9	103 1.4	385 5.4	.....	1,976 28.0	3,446 48.7	7,086 100	107,000 100	7,086 6.6			No. %
1913.....	412 5.6	132 1.8	1,792 24.3	357 4.8	2,916 40.0	4,008 54.5	7,366 100	109,643 100	7,366 6.7			No. %
1914.....	316 4.2	111 1.5	1,137 15.0	263 3.5	1,864 24.6	4,591 60.6	7,571 100	112,096 100	7,571 6.8			No. %
1915.....	289 3.7	113 1.5	1,615 20.9	341 4.4	2,145 27.7	5,111 66.1	7,747 100	114,332 100	7,747 6.8			No. %
1916.....	361 4.6	181 2.3	1,555 19.6	372 4.7	2,364 30.3	5,684 72.6	7,927 100	116,000 100	7,927 6.7			No. %
1917.....	495 5.9	96 1.2	1,378 16.5	388 4.7	2,173 26.1	6,315 75.9	8,326 100	117,270 100	8,326 7.1			No. %
1918.....	296 3.5	114 1.3	1,548 18.2	393 4.6	1,448 17.0	6,643 78.0	8,508 100	118,122 100	8,508 7.2			No. %
Meters Installed.....	City.....	157	36	37	1½"	5	10	9	6"	8"	Total	
	Private...	1	0	0	0	0	0	0	0	0	295	
Total.....		158	36	37	33	5	10	9	8	0	296	
Meters Condemned.....	City.....	192	34	23	10	10	12	10	2	0	293	
Meters Replaced.....	Private...	66	12	9	4	7	0	2	0	0	100	
Total.....		258	46	32	14	17	12	12	2	0	393	
Meters Removed.....	City.....	50	14	6	6	6	2	5	0	0	89	
	Private...	16	1	3	2	2	1	0	0	0	25	
Total.....		66	15	9	8	8	3	5	0	0	114	

TABLE No. 65. SIZE AND NUMBER OF METERS IN SERVICE, APRIL 1st, 1918.

Make of Meters.	City $\frac{5}{8}$ Inch	Private $\frac{5}{8}$ Inch	City $\frac{3}{4}$ Inch	Private $\frac{3}{4}$ Inch	City 1 Inch	Private 1 Inch	City $1\frac{1}{2}$ Inch	Private $1\frac{1}{2}$ Inch	City 2 Inch	Private 2 Inch	City 3 Inch	Private 3 Inch	City 4 Inch	Private 4 Inch	City 6 Inch	Private 6 Inch	City 8 Inch	Private 8 Inch	Total City	Total Private	Grand Total
Crown.....	1,009	260	186	89	172	69	103	27	247	45	91	20	72	14	16	2	.....	.....	1,896	526	2,422
Nash "K".....	.....	.....	81	.....	46	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	127	.....	127
Hershey Rotary...	73	364	77	103	225	75	120	47	245	50	87	12	55	12	9	.....	.....	.....	663	891	1,554
Hershey Disc....	1,145	117	10	37	11	29	6	8	4	3	18	4	6	4	5	.....	.....	.....	1,207	198	1,405
Hershey Torment	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	24	9	33
Hershey Detector	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3	.....	.....	15	15
Worthington	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Piston.....	1	17	.....	10	1	4	.....	3	1	2	.....	3	.....	3	.....	.....	.....	.....	3	42	45
Worthington	776	155	153	49	125	63	156	41	69	38	51	3	20	2	9	.....	.....	.....	1,359	351	1,710
Disc.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Worthington	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Turbine.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Keystone.....	125	9	71	2	31	3	5	.....	2	1	14	.....	12	2	13	.....	.....	.....	39	2	41
Trident.....	378	.....	129	.....	27	.....	4	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	234	15	249
Trident Crest...	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	8	1	5	3	.....	.....	538	1	539
Lambert.....	10	12	239	6	1	.....	16	.....	3	.....	2	.....	5	5	1	.....	.....	.....	15	4	19
Nilo.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	14	1	9	2	6	.....	.....	.....	289	18	307
Miscellaneous...	.....	8	.....	4	.....	2	.....	.....	.....	.....	6	1	.....	.....	2	.....	.....	2	21	3	24
Total.....	3,517	942	946	300	639	245	410	127	571	139	287	43	199	44	88	5	3	3	6,643	1,865	8,508

TABLE No. 66.  
SIZE AND NUMBER OF TAPS INSERTED IN MAIN FROM APRIL 1st, 1917, TO APRIL 1st, 1918.

MONTH	½-inch	¾-inch	1-inch	1¼-inch	1½-inch	1¾-inch	2-inch	Total
April, 1917.....	65	22	17	.....	.....	.....	.....	104
May, 1917.....	233	34	17	.....	.....	.....	.....	284
June, 1917.....	105	17	5	.....	.....	.....	.....	127
July, 1917.....	69	19	31	.....	.....	.....	.....	119
August, 1917.....	59	13	19	.....	.....	.....	.....	91
September, 1917.....	62	19	5	.....	.....	.....	.....	86
October, 1917.....	49	7	12	.....	.....	.....	.....	68
November, 1917.....	47	12	9	.....	.....	.....	.....	68
December, 1917.....	21	2	6	.....	.....	.....	.....	29
January, 1918.....	6	0	1	.....	.....	.....	.....	7
February, 1918.....	44	2	8	.....	.....	.....	.....	54
March, 1918.....	111	14	21	.....	.....	.....	.....	146
Total.....	871	161	151	.....	.....	.....	.....	1,183
Total May, 1867, to April 1st, 1917.....	94,300	16,241	8,604	911	33	10	8	120,698
Total.....	95,171	16,402	8,755	911	33	10	8	121,881

Taps inserted previous to May, 1867..... 5,060  
Taps inserted since May, 1867, as per table..... 121,881

Total number inserted to April 1st, 1918..... 126,941

Taps taken out previous to April 1st, 1917..... 8,474  
Taps taken out from April 1st, 1917, to April 1st, 1918..... 345

Total number taken out to April 1st, 1918..... 8,819

Total number in service April 1st, 1918..... 118,122

TAPS TAKEN OUT FROM APRIL 1st, 1917, TO APRIL 1st, 1918.

½-inch	¾-inch	1-inch	1¼-inch	1½-inch	2-inch	Total
81	137	13	4	0	0	345

TABLE No. 67.  
LEAKS REPORTED BY INSPECTION BRANCH.

MONTHS	Number of Inspections	Number in Good Order	Number of Leaks	LEAKS REPORTED BY				Number of Notices Served	Repaired Upon Receipt of Notice	Not Repaired Shut Off
				Inspectors	Telephone	Police	Tenants			
April, 1917.....	10,420	9,765	655	501	70	46	38	655	618	37
May, 1917.....	13,761	13,105	656	520	37	61	38	656	602	54
June, 1917.....	10,121	9,644	477	360	34	45	38	477	433	44
July, 1917.....	8,653	8,207	446	310	11	73	52	446	431	15
August, 1917.....	11,465	10,903	562	456	27	39	40	562	510	52
September, 1917.....	12,800	12,205	595	478	32	53	32	595	563	32
October, 1917.....	13,650	13,029	621	486	22	51	62	621	611	10
November, 1917.....	16,175	15,348	827	674	65	45	43	827	798	29
December, 1917.....	8,830	8,012	818	339	139	166	174	818	742	76
January, 1918.....	6,102	5,207	895	261	165	205	264	895	815	80
February, 1918.....	6,704	5,943	761	273	123	194	171	761	748	13
March, 1918.....	18,510	17,430	1,080	760	189	76	55	1,080	1,061	19
Total.....	137,191	128,798	8,393	5,418	914	1,054	1,007	8,393	7,932	461

TABLE No. 68. DETAIL OF NOTICES SERVED ON ACCOUNT OF WASTE OF WATER.

MONTH	Hydrants	Faucets	Toilets	Ser- vice Pipes	Street Washers	Builders' Taps	Stop and Waste	Stop Boxes	Foun- tains	Meters	Fire Hy- drants	Sprin- kler Plugs	Mains	Total
April, 1917.....	109	99	257	175	3	0	3	4	5	0	0	0	0	655
May, 1917.....	102	82	286	175	1	1	0	5	4	0	0	0	0	656
June, 1917.....	64	72	212	116	4	0	1	3	5	0	0	0	0	477
July, 1917.....	37	81	200	105	10	0	3	3	7	0	0	0	0	446
August, 1917.....	49	123	268	102	0	0	8	10	2	0	0	0	0	562
September, 1917.....	50	120	281	111	0	3	2	3	25	0	0	0	13	621
October, 1917.....	34	138	294	116	4	0	6	8	8	0	0	0	20	827
November, 1917.....	72	153	458	103	6	0	3	7	5	0	0	0	8	818
December, 1917.....	45	188	457	457	2	0	7	5	18	0	0	0	3	895
January, 1918.....	89	66	149	553	8	0	13	4	10	0	0	0	13	761
February, 1918.....	84	55	109	456	12	0	2	7	7	9	5	2	0	1,080
March, 1918.....	126	139	506	259	3	0	5	3	10	2	1	0	6	1,080
Total.....	861	1,236	3,208	2,728	53	4	53	62	106	11	6	2	63	8,393

**TABLE No. 69.**  
**SERVICES SHUT AND RESUMED.**

MONTH	Services Shut Account			Services Resumed
	Delinquents	To Value	Vacant	
April, 1917.....	96	218	249	519
May, 1917.....	142	203	386	497
June, 1917.....	195	170	415	387
July, 1917.....	223	176	309	391
August, 1917.....	92	193	509	373
September, 1917.....	180	268	284	517
October, 1917.....	106	318	351	362
November, 1917.....	99	240	536	257
December, 1917.....	82	177	351	203
January, 1918.....	68	166	528	208
February, 1918.....	129	177	768	322
March, 1918.....	258	164	571	551
Total.....	1,670	2,470	5,257	4,588

**TABLE No. 70.**  
**NUMBER OF INSIDE FIRE HYDRANTS AND AUTOMATIC SPRINKLER SYSTEMS EXAMINED AND RESEALED.**

MONTH	Number of Inside Connections Examined	Number of Seals Found O. K.	Number of Connections Resealed	Number of Seals Broken Authorized	Number of Seals Broken Unauthorized
April, 1917....	7,437	7,257	180	180	.....
May, 1917....	8,379	8,184	195	195	.....
June, 1917....	6,875	6,712	163	163	.....
July, 1917....	8,098	7,831	267	267	.....
August, 1917....	7,314	7,162	152	152	.....
September, 1917....	5,486	5,350	136	136	.....
October, 1917....	6,432	6,258	174	174	.....
November, 1917....	7,636	7,260	376	376	.....
December, 1917....	6,691	6,441	250	250	.....
January, 1918....	8,521	8,224	297	297	.....
February, 1918....	5,634	5,458	176	176	.....
March, 1918....	7,972	7,716	256	256	.....
Total.....	86,475	83,853	2,622	2,622	.....

## ASSESSMENT SECTION.

### REPORT OF SUPERVISOR.

St. Louis, Mo., April 20, 1918.

HONORABLE EDWARD E. WALL,  
Water Commissioner.  
Building.

DEAR SIR: I beg to submit the following report of the Assessment Section for the year ending April 1st, 1918:

There has been no material change in the work of this section, as the present Ordinance covering the Assessment of Water Rates has been in effect since March 31st, 1916.

Collections for this year were the largest in the history of the Water Division, being \$112,015.01 greater than the largest previous year, 1912 and 1913. The increase over last year was \$145,450.30, made up as follows:

Increase.

Meter accounts.....\$131,040.84

Flat and miscellaneous... 15,619.96

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Gross increase..... \$146,660.80

Decrease.

Tap permits..... 1,210.50

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Net increase..... \$145,450.30

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There was a decrease this year of 1,230 miscellaneous permits, which covers the use of water for building construction, streets and sidewalks. The largest number of permits issued was 465 during May, 1917, and the smallest number 85, during January, 1918.

In the past year the twelve District Inspectors have made 31,290 inspections, of which 8,673 were requested by consumers for corrections on flat rate bills, being a decrease from last year of 12,876 requests. The balance of the inspections were for additional plumbing fixtures, for new remodeled buildings and for specials that were considered necessary.

The decrease in requests for inspections is attributed to the fact that the consumers in general have become better acquainted with the ordinance governing the use of water and the assessment therefor, as well as to fewer complaints of erroneous charges for the use of hose.

When water license has been paid for any premises at flat rates, if part of the premises becomes vacant not less than sixty days before the expiration of the license and a report is filed by the consumer in this office, a refund for that proportion of the license will be allowed at the expiration of the license. When the report is filed, an inspection is made at once to verify it, and the premises are reinspected in sixty days. If found entitled to a refund, a notice to that effect is issued and mailed to the consumer. If not, a postal card is mailed, stating why the refund can not be allowed.

In the past year 11,739 reports for partial vacancies were filed, of which 8,839 were inspected twice and allowances authorized. The remainder were filed in error and the refunds asked for could not be allowed. These reports were handled by three inspectors and cover the entire city.

Refunds are also allowed on premises that become totally vacant before the expiration of the license paid. In order to collect the refund it is necessary to notify this office, either in writing or in person, to discontinue water service. After the water is shut off, which, as a rule, is two or three days after notification, it is then necessary to present the license on which the refund is due, when a voucher will be drawn on the treasurer for the amount of the refund.

Two thousand four hundred and eighty-four requests were received to discontinue water service and refund the unexpired portion of license; in 615 of these cases no refunds were made, as consumers failed to call for them.

The two clerks necessary for transacting all business relative to refunds must be Notaries Public, since affidavits must be taken for all refunds allowed for partial vacancies of more than sixty days' duration. They are required to check and calculate all refunds and issue vouchers therefor. In the past year they have issued 7,663 vouchers for refunds, distributed as follows:

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Partial vacancies.....	\$27,613.50
Unexpired licenses.....	11,462.93
Flat rate licenses refunded where meters were installed....	881.79
Miscellaneous and overcharge on account of change in assessment.....	14,111.87
	<hr/> \$54,070.09

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The four Ford Runabouts used by the meter readers had been in constant use every day except Sundays and holidays since 1912, and it was necessary to replace them. The department purchased four new cars of the same type, the boxes on the rear being reconstructed by the department carpenters at the Pipe Yards, so as to more conveniently carry the equipment necessary for meter reading: keys, shovel, bucket, overalls, etc.

There are 8,508 meters in service; each meter is usually read once a month. This year, during the extreme weather of January and February, it was practically impossible to get to the meter boxes on account of their being covered with snow and ice, an unusual condition for this locality. A number of meters were frozen, and in order to furnish water to these premises it was necessary to remove the frozen meters and temporarily connect the supply pipes without meters, which necessitated estimating the amount of water consumed. These estimates were based on the consumption before and after the time the meters were out of service, which proved to be a very satisfactory adjustment to all concerned.

The number of employes in this section is the same as last year, fifty-three, of which twenty-three are outside men (fifteen inspectors and eight meter readers), leaving an office force of thirty. Their duties are as follows:

One supervisor; general supervision of all work, both clerical and otherwise, pertaining to the assessment of water.

One chief clerk; handling office and outside work, complaints and all work in general.

One stenographer; writing of all correspondence (daily letter average sixty-five), statements and filing of same.

Two refund clerks; handling all refunds.

Two draftsmen; plating and checking installation and removal of taps and meters, correcting house numbers and street names on plat books and maps and making new plats.

Thirteen record clerks; posting inspections on flat rate records, issuing and abstracting bills and checking same with inspectors' reports.

Four meter clerks; posting meter readings, issuing and abstracting meter bills, ordering the installation and removal of meters and notifying consumers of excessive consumption or leaks.

Two counter clerks; handling complaints, applications for water and other necessary information.

One plan estimator; estimates consumption of water for building construction, sidewalks and streets, and issues bill for same.

One clerk ; records all requests for reinspection, telephone information, and checks installation of additional plumbing fixtures.

One clerk ; posts refunds to abstract and general office work.

Twelve inspectors ; inspecting premises to estimate charge for flat rate license, recording same and checking bills with their records the first part of each month.

Three inspectors ; inspecting partially vacant buildings to verify requests for refund, and reporting on same.

Eight meter readers ; reading and recording registration of meters and inspecting and reporting leaks on metered premises.

One janitor ; taking care of all necessary janitor work in the entire office.

It was considered advisable to readjust the various meter and flat rates as established by Ordinance 28,526, making it necessary to draw up an entirely new ordinance for introduction in the Board of Aldermen.

In order to draw a new ordinance it was necessary to compile considerable data so as to arrive at more equitable charges. This required a great deal of extra work, and was taken care of by the regular office force, without any additional help.

The proposed ordinance was drawn on the basis of readjustment and simplification of all rates in general, rather than to provide an increase of revenue. The principal changes were as follows :

### METER RATE.

The present ordinance provided for

- 111 rates for general consumers.
- 5 rates for manufacturers.
- 1 rate for swimming pools.
- Charitable institutions  $\frac{1}{2}$  the regular rate.

The proposed ordinance establishes

- 12 rates for general consumers.
- 3 rates for manufacturers.
- 1 rate for swimming pools.
- 1 rate for charitable institutions.

Eliminates the charity rate except where the premises are supplied through meters, and abolishes the 10 per cent discount allowed for payment of bills within ten days of the date due, on all special rates, such as those allowed to manufacturers, swimming pools and charitable institutions.

### FLAT RATE.

A reduction of practically 10 per cent was made on the various charges affected by the elimination of refunds on partial vacancies, which was estimated to be the amount of the difference to consumers.

The assessing of offices, shops, halls, stores, storerooms and warehouses was materially changed from the method established in the past, by which they have been assessed on a sliding scale from \$3.00 to \$40.00 per year, according to the inspector's report. The new ordinance provides for assessing on the basis of floor area, which should prove a great deal more satisfactory to the consumer, as well as to the department, since it eliminates any question of incorrect assessment. The assessing by floor area will necessitate the measuring of every building assessed on that basis before bills can be issued, and will require twelve extra inspectors for six months to assist the regular inspectors with these measurements and in correcting their field books according to the new inspections and charges. It will also require a great deal of additional work in this office, as it will be necessary to show the floor measurements on the bills and also to correct the card records accordingly. This additional work will be taken care of without any extra help.

In the past year, in addition to the above stated extra work, keeping the plat books posted, showing the installation of new, and destruction of old taps, also installation and removal of meters, correction of flat rate records, correction of house numbers in accordance with the House Numbering Division, installation of additional fixtures, wrecking of buildings, additions to new buildings, posting meter readings, issuing refund vouchers, taking applications for water for new tenants and handling complaints relative to water license (both flat and meter rate), we have issued the following bills:

201,644.....	Flat Rate
12,373.....	Meter
3,418.....	Miscellaneous
4,073.....	New Tenants
14,087.....	Corrected
236,595.....	Total

Yours very truly,

WM. T. KIRCHEIS,  
Supervisor Assessment Section.

TABLE No. 71.

COMPARATIVE STATEMENT OF METERS AND ELEVATORS  
IN USE, AND THE REVENUE DERIVED THEREFROM.

FISCAL YEAR	Number of Elevators	Number of Meters		Total	Amount Collected
		Property of City	Property of Consumer		
1873-1874.....				212	
1874-1875.....				231	
1875-1876.....				245	
1876-1877.....				289	
1877-1878.....	95			318	\$ 113,454.08
1878-1879.....	114	276	87	363	127,616.17
1879-1880.....	126	299	136	435	142,849.50
1880-1881.....	139	318	255	573	180,904.35
1881-1882.....	154	437	468	905	222,397.00
1882-1883.....	164	563	665	1,228	244,119.77
1883-1884.....	161	681	841	1,522	247,489.81
1884-1885.....	163	709	1,102	1,811	246,344.50
1885-1886.....	177	723	1,420	2,143	273,175.50
1886-1887.....	201	727	1,649	2,376	322,846.15
1887-1888.....	212	745	1,917	2,662	350,136.50
1888-1889.....	227	742	2,146	2,888	369,044.40
1889-1890.....	237	712	2,403	3,115	415,999.50
1890-1891.....	240	724	2,675	3,399	514,417.00
1891-1892.....	252	739	2,862	3,601	539,562.00
1892-1893.....	253	727	3,023	3,750	555,850.50
1893-1894.....	251	712	3,138	3,850	531,030.50
1894-1895.....	249	704	3,275	3,979	521,204.50
1895-1896.....	232	689	3,403	4,092	500,443.00
1896-1897.....	236	685	3,512	4,197	529,226.00
1897-1898.....	231	594	3,557	4,151	540,710.00
1898-1899.....	223	582	3,452	4,034	538,025.00
1899-1900.....	213	554	3,579	4,133	546,672.00
1900-1901.....	212	614	3,717	4,331	620,723.00
1901-1902.....	199	655	3,870	4,525	708,369.00
1902-1903.....	171	692	3,943	4,635	760,545.50
1903-1904.....	169	912	3,931	4,843	773,365.10
1904-1905.....	153	904	4,082	4,986	1,025,656.40
1905-1906.....	6	1,205	4,073	5,278	680,205.95
1906-1907.....	6	1,539	3,887	5,426	663,595.39
1907-1908.....	3	1,878	3,703	5,581	785,328.64
1908-1909.....		2,385	3,751	6,116	719,424.45
1909-1910.....		2,627	3,904	6,531	836,618.68
1910-1911.....		3,121	3,835	6,956	885,488.36
1911-1912.....		3,376	3,756	7,132	940,434.75
1912-1913.....		3,995	3,304	7,299	886,273.36
1913-1914.....		4,636	2,898	7,534	871,785.00
1914-1915.....		5,117	2,630	7,747	779,038.02
1915-1916.....		5,684	2,243	7,927	805,029.11
1916-1917.....		6,315	2,011	8,326	872,588.47
Year ending March 31st, 1918.....		6,643	1,865	8,508	1,003,629.31

TABLE No. 72.

# YEARLY REVENUE DERIVED FROM WATER RATES FROM FIRST INTRODUCTION INTO THE CITY.

FROM	TO	Annual Collections	Increase	Decrease
Total receipts up to	May 14, 1835	\$ 23,453.51		
May 14, 1835	April, 1836	4,588.73		
April, 1836	April, 1837	5,338.21	\$ 748.48	
April, 1837	April, 1838	8,372.13	3,033.92	
April, 1838	April, 1839	12,694.11	4,321.98	
April, 1839	April, 1840	20,517.25	7,823.14	
April, 1840	April, 1841	20,672.16	154.91	
April, 1841	April, 1842	14,954.31		\$ 5,717.85
April, 1842	April, 1843	12,507.81		2,446.50
April, 1843	April, 1844	13,402.10	849.29	
April, 1844	April, 1845	14,518.69	1,016.59	
April, 1845	April, 1846	15,442.47	923.78	
April, 1846	April, 1847	17,858.70	2,416.23	
April, 1847	April, 1848	25,538.48	7,679.78	
April, 1848	April, 1849	21,967.92		3,570.56
April, 1849	April, 1850	19,560.00		2,407.92
April, 1850	April, 1851	30,943.78	11,383.78	
April, 1851	April, 1852	30,824.85		118.93
April, 1852	April, 1853	36,995.38	6,170.53	
April, 1853	April, 1854	49,865.04	12,869.66	
April, 1854	April, 1855	51,735.29	1,870.25	
April, 1855	April, 1856	70,380.47	18,645.18	
April, 1856	April, 1857	68,597.20		1,783.27
April, 1857	April, 1858	84,021.96	15,424.76	
April, 1858	April, 1859	87,352.20	3,330.24	
April, 1859	April, 1860	99,501.88	12,149.68	
April, 1860	April, 1861	114,760.35	15,258.47	
April, 1861	April, 1862	123,690.25	8,920.90	
April, 1862	April, 1863	147,120.95	23,430.70	
April, 1863	April, 1864	170,313.30	23,192.35	
April, 1864	April, 1865	208,340.90	38,027.60	
April, 1865	April, 1866	247,268.33	39,927.43	
April, 1866	May 1, 1867	248,575.30	306.97	
May 1, 1867	May 1, 1868	288,910.07	40,334.77	
May 1, 1868	May 1, 1869	321,412.50	32,502.43	
May 1, 1869	May 1, 1870	323,102.00	1,629.50	
May 1, 1870	May 1, 1871	335,626.91	12,524.91	
May 1, 1871	May 1, 1872	373,194.60	37,567.69	
May 1, 1872	May 1, 1873	426,922.59	53,727.99	
May 1, 1873	May 1, 1874	444,623.35	17,699.76	
May 1, 1874	May 1, 1875	414,870.44		29,751.91
May 1, 1875	May 1, 1876	456,163.39	41,292.95	
May 1, 1876	April 9, 1877	445,041.14		11,122.25
April 10, 1877	April 8, 1878	512,053.19	67,012.05	
April 9, 1878	April 7, 1879	550,140.60	38,087.41	
April 8, 1879	April 12, 1880	620,280.30	70,139.70	
April 13, 1880	April 11, 1881	660,024.75	39,744.45	
April 12, 1881	April 10, 1882	706,145.65	46,120.90	
April 11, 1882	April 9, 1883	719,686.37	13,540.72	
April 11, 1883	April 7, 1884	736,694.26	17,007.89	
April 8, 1884	April 13, 1885	759,265.53	22,571.27	
April 14, 1885	April 12, 1886	800,325.70	41,060.17	
April 13, 1886	April 11, 1887	868,043.25	67,717.55	
April 12, 1887	April 9, 1888	919,975.18	51,931.93	
April 10, 1888	April 8, 1889	952,689.25	32,714.07	
April 9, 1889	April 7, 1890	1,017,016.20	64,326.95	
April 8, 1890	April 13, 1891	1,132,088.40	115,072.20	
April 14, 1891	April 11, 1892	1,173,998.30	41,909.90	
April 12, 1892	April 10, 1893	1,235,933.30	61,935.00	
April 11, 1893	April 9, 1894	1,250,935.25	15,001.95	
April 10, 1894	April 8, 1895	1,264,253.60	13,318.35	
April 9, 1895	April 13, 1896	1,310,412.45	46,156.85	
April 14, 1896	April 12, 1897	1,335,635.20	25,222.75	
April 12, 1897	April 11, 1898	1,388,564.45	52,929.25	
April 12, 1898	April 10, 1899	1,379,361.40		9,203.05
April 11, 1899	April 9, 1900	1,482,053.80	102,692.40	
April 10, 1900	April 8, 1901	1,607,168.82	125,115.02	
April 9, 1901	April 7, 1902	1,756,565.90	149,397.08	
April 8, 1902	April 13, 1903	1,748,541.21		8,024.69
April 14, 1903	April 11, 1904	1,707,573.75		40,967.46
April 12, 1904	April 10, 1905	1,993,381.65	285,807.90	
April 11, 1905	April 9, 1906	1,702,132.97		291,248.68
April 10, 1906	April 8, 1907	1,740,260.53	38,127.56	
April 9, 1907	April 13, 1908	1,926,651.05	186,390.52	
April 14, 1908	April 12, 1909	1,862,205.15		64,445.90
April 13, 1909	April 11, 1910	2,028,445.14	166,239.99	
April 12, 1910	April 10, 1911	2,080,363.01	51,817.87	
April 11, 1911	April 8, 1912	2,156,350.55	75,987.54	
April 9, 1912	April 7, 1913	2,421,914.16	265,563.61	
April 8, 1913	April 13, 1914	2,268,506.93		153,407.23
April 14, 1914	March 31, 1915	2,163,281.10		105,225.83
April 1, 1915	March 31, 1916	2,220,426.92	57,145.82	
April 1, 1916	March 31, 1917	2,388,478.87	168,051.95	
April 1, 1917	March 31, 1918	2,533,929.17	145,450.30	
		\$65,034,293.26		

**TABLE No. 73.**  
**NUMBER AND SIZE OF TAPS ISSUED.**

DATE	1½-inch \$ 3.00	5⁄8-inch \$ 3.15	¾-inch \$ 3.65	Amount Assessed Each Month
April, 1917.....	65	22	17	\$326.35
May, 1917.....	233	34	17	868.15
June, 1917.....	105	17	5	386.80
July, 1917.....	69	19	31	380.00
August, 1917.....	59	13	19	287.30
September, 1917.....	62	19	5	264.10
October, 1917.....	49	7	12	212.85
November, 1917.....	47	12	9	211.65
December, 1917.....	21	2	6	91.20
January, 1918.....	6	0	1	21.65
February, 1918.....	44	2	8	167.50
March, 1918.....	111	14	21	453.75
Total.....	871	161	151	\$3,671.30

**TABLE No. 74.**  
**COLLECTIONS BY CALENDAR YEARS,**  
**BEGINNING JANUARY 1st, 1876.**

CALENDAR YEAR	Amount Collected	Increase
1876.....	\$ 472,227.59	.....
1877.....	499,102.02	\$ 26,748.43
1878.....	522,018.26	23,006.24
1879.....	593,067.06	81,048.80
1880.....	653,167.14	60,100.08
1881.....	693,869.26	40,801.12
1882.....	716,972.37	22,104.11
1883.....	735,722.41	29,650.04
1884.....	755,345.00	9,623.19
1885.....	803,414.04	48,068.44
1886.....	850,415.70	47,001.66
1887.....	924,003.07	73,587.37
1888.....	963,130.55	12,127.48
1889.....	978,670.15	42,539.60
1890.....	1,081,193.60	102,523.45
1891.....	1,170,159.50	88,965.90
1892.....	1,223,477.35	63,317.85
1893.....	1,246,523.05	14,045.70
1894.....	1,266,395.65	18,872.55
1895.....	1,280,782.00	14,386.35
1896.....	1,346,721.85	65,939.85
1897.....	1,365,056.10	16,334.25
1898.....	1,404,165.45	41,109.35
1899.....	1,429,061.15	24,895.70
1900.....	1,591,062.42	162,001.27
1901.....	1,725,087.95	134,025.53
1902.....	1,770,242.56	45,154.61
1903.....	1,725,140.90	* 45,101.66
1904.....	1,917,831.02	192,690.12
1905.....	1,807,245.02	*110,585.99
1906.....	1,687,953.27	*119,291.76
1907.....	1,908,824.88	220,771.61
1908.....	1,830,870.15	* 77,854.73
1909.....	1,983,778.50	152,908.35
1910.....	2,077,496.30	93,717.80
1911.....	2,178,371.15	100,874.85
1912.....	2,290,004.66	111,633.51
1913.....	2,350,676.98	60,672.32
1914.....	2,267,668.78	* 83,008.20
1915.....	2,172,469.58	* 95,199.20
1916.....	2,280,209.96	107,740.38
1917.....	2,570,309.64	290,099.68

\* Decrease.

TABLE No. 75.  
FLAT RATE CARDS.

DISTRICT	1	2	3	4	5	6	7	8	9	10	11	12	Total
January-July..	1,562	1,489	1,603	1,621	1,569	1,287	1,493	1,425	1,853	874	1,493	859	17,128
February-Aug..	1,867	1,843	1,617	1,697	1,237	1,489	1,953	1,263	1,991	1,317	2,021	1,397	19,692
March-Sept...	2,044	1,331	1,417	1,376	1,664	1,332	1,928	1,284	1,772	1,370	1,620	828	17,966
April-October..	1,894	1,785	1,580	1,244	1,839	842	1,023	1,349	1,582	583	754	588	15,063
May-Nov.....	2,327	1,654	1,552	1,534	1,643	976	888	1,597	1,476	352	1,017	394	15,410
June-Dec.....	2,180	1,962	1,483	1,808	1,047	739	1,384	1,585	999	653	976	747	15,563
Total.....	11,874	10,064	9,252	9,280	8,999	6,665	8,669	8,503	9,673	5,149	7,881	4,813	100,822

TABLE No. 76.  
BOUNDARIES OF FLAT RATE DISTRICTS.  
OFFICE OF ASSESSMENT OF WATER RATES.

District	North	South	East	West
1	Arsenal St.....	City Limits.....	Wharf.....	Grand Ave.
2	Miller St. and Park Ave.	Arsenal St.....	Wharf.....	Grand Ave.
3	Washington Ave.....	Miller St. and Park Ave.	Wharf.....	Grand Ave.
4	North Market St.....	Washington Ave.....	Wharf.....	Grand Ave.
5	City Limits.....	North Market St.....	Wharf.....	Grand and Florissant Aves.
6	Florissant Ave.....	Natural Bridge Ave.....	Grand Ave.....	City Limits.
7	Natural Bridge Ave..	North Market St.... St. Ferdinand Ave.... Hammett Place..... Arlington Ave..... Easton Ave.....	Grand Ave.....	City Limits.
8	North Market St.... St. Ferdinand Ave.... Hammett Place..... Branconier Place.... Arlington Ave..... Easton Ave..... Page Blvd.....	Page Blvd..... Union Blvd..... Maple Ave.....	Grand Ave.....	City Limits.
9	Union Blvd..... Maple Ave.....	Lindell Blvd.....	Grand Ave.....	City Limits.
10	Lindell Blvd.....	Park Ave..... Kingshighway..... Race Course..... Manchester Ave.....	Grand Ave.....	City Limits.
11	Park Ave..... Kingshighway..... Race Course..... Manchester..... McDonald Ave.....	McDonald Ave..... Fyler Ave..... Frisco Ave.....	Grand Ave.....	City Limits.
12	Fyler Ave..... Frisco Ave.....	City Limits.....	Grand Ave.....	City Limits.

TABLE No. 77.

BOUNDARIES OF THE METER DISTRICTS,  
OFFICE OF ASSESSMENT OF WATER RATES.

District	North	South	East	West
A	{ Miller St..... Park Ave..... Race Course..... Kingshighway..... Oakland..... }	City Limits.....	Wharf.....	City Limits.
B	Pine St.....	{ Miller St..... Park Ave..... Race Course..... Kingshighway..... Oakland..... }	Wharf.....	City Limits
C	{ Florida St..... Cass Ave..... Easton Ave..... }	{ Pine St..... Lindell Blvd..... }	Wharf.....	City Limits.
D	City Limits.....	{ Florida St..... Cass Ave..... Easton Ave..... }	Wharf.....	City Limits.



TABLE No. 79.

**AMOUNT ASSESSED BY METER RATE, APRIL, 1917, TO  
MARCH, 1918, INCLUSIVE.**

DISTRICT	Due	Amount
B.....	April, 1917.....	\$172,108.14
C.....	May, 1917.....	182,003.63
D.....	June, 1917.....	80,229.18
A.....	September, 1917.....	119,469.01
B.....	October, 1917.....	130,440.32
C.....	November, 1917.....	137,440.03
D.....	December, 1917.....	85,770.59
A.....	March, 1918.....	97,160.74
SPECIAL		
Government, Schools, Libraries and United Railway	July, 1917.....	47,215.58
Government, Schools, Libraries and United Railway	January, 1918.....	30,372.85
Total.....	.....	\$1,082,210.07

TABLE No. 80.  
TOTAL COLLECTIONS FOR WATER, APRIL 1st, 1917, TO MARCH 31st, 1918, INCLUSIVE

	Flat Rate Bills	Building Permits	Filling Cisterns	Taps	Dig Bills	Meter Bills	Total
1917							
April.....	\$ 106,396.06	\$ 1,586.36	\$ 6.30	\$ 352.30	\$ 8.00	\$156,573.75	\$264,922.77
May.....	121,253.66	1,937.69	9.00	837.55	14.00	182,195.81	286,217.71
June.....	119,277.14	1,219.20	6.30	393.40	20.00	88,821.71	209,737.75
July.....	152,002.84	1,464.43	25.20	394.85	6.00	46,194.25	200,087.57
August.....	153,665.15	974.74	9.90	296.60	30.00	6,388.16	161,364.55
September.....	133,140.11	1,080.67	6.30	264.10	18.00	90,077.59	224,586.77
October.....	102,131.09	1,280.92	12.60	209.20	6.00	116,949.05	220,588.86
November.....	101,756.91	536.86	10.80	215.15	16.00	120,227.22	222,782.94
December.....	96,913.35	320.77	11.70	91.20	6.00	77,282.70	174,625.72
1918							
January.....	149,550.96	110.66	9.00	15.65	6.00	29,684.01	179,376.28
February.....	135,881.78	262.28	14.40	163.85	8.00	16,531.55	152,861.86
March.....	142,923.37	619.61	19.35	460.55	20.00	92,703.48	236,746.36
Total.....	\$1,514,892.42	\$11,414.19	\$140.85	\$3,694.40	\$158.00	\$1,003,629.31	\$2,533,929.17

## FINANCIAL STATEMENT.

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### REPORT OF THE ACCOUNTANT.

St. Louis, Mo., May 1st, 1918.

HON. EDWARD E. WALL,  
Water Commissioner, City.

DEAR SIR: I herewith submit financial statement for the various sections of the Water Division for the year ending April 1st, 1918.

Respectfully submitted,

JOHN FAUDI,  
Accountant.

**TABLE No. 81.**

**DETAILED STATEMENT.**

**OPERATION AND MAINTENANCE.**

**EXPENDITURES.**

Commissioner's Office.....	\$ 21,441.26
Assistant Commissioner's Office.....	16,604.94
Operating Section—Bissell's Point Branch.....	164,758.43
Operating Section—Baden Branch.....	165,498.25
Operating Section—Chain of Rocks Branch.....	164,298.39
Operating Section—Sanitarium Branch.....	101,622.33
Operating Section—Construction Branch.....	14,791.56
Supply and Purifying Section.....	506,383.01
Distribution Section—Street Service Branch.....	273,712.73
Distribution Section—Meter and Tap Branch.....	47,391.28
Distribution Section—Inspection Branch.....	44,734.28
Assessment Section.....	71,375.89
Total gross expenses for operation and maintenance.....	\$1,592,612.35

**RECEIPTS.**

Commissioner's Office.....	\$ 787.18
Operating Section.....	5,215.49
Supply and Purifying Section.....	10,814.26
Distribution Section—Street Service Branch.....	39,481.20
Distribution Section—Meter and Tap Branch.....	3,817.45
	\$ 60,115.58
Cost of furnishing heat, light, power and refrigeration, for Sanitarium, Infirmary and Infectious Hospital.....	\$ 94,102.29
Cost of furnishing labor and material, Power Plants, Department of Public Utilities.....	1,367.95
Cost of furnishing labor and material—Other Departments.....	4,205.47
	159,791.29
Net cost of operation and maintenance of Works.....	\$1,432,821.06

**EXTENSION AND RECONSTRUCTION WORK.**

For extending Distribution System.....	\$181,558.03
For Construction of Filter and Filter Equipment—Chain of Rocks Branch.....	420.00
For Reconstruction of Boiler Plant—Chain of Rocks Branch.....	1,158.81
For Reconstruction of Pumping Plant No. 2—Bissell's Point Branch.....	34,519.33
For Construction of Smokestack, etc.—Chain of Rocks Branch.....	575.19
For Installation of Equipment necessary for the operation of Pumping Engines—Pumping Plant No. 1—Bissell's Point Branch.....	693.60
For Reconstruction of Compton Hill Reservoir.....	60,774.58
For Construction of a reinforced Conduit, etc., between High Service Stations—Baden and Bissell's Point.....	117,366.47
For Construction of a Brick and Concrete Smokestack, etc.—Bissell's Point Branch.....	24,652.77
For the Installation of one 100-million-gallons Steam Turbine Driven Centrifugal Pump, etc.—Chain of Rocks Branch.....	5,790.80
For Wrecking and Rebuilding No. 111 Chestnut Street.....	11,209.33
For Purchasing and Installing 3 New Cylinder Heads, Engines Nos. 1, 2, and 3—Bissell's Point Branch.....	4,715.08
For Construction and Extension of Hurdle Dikes into Mississippi River opposite Chain of Rocks Branch.....	74,786.44
For Construction of two 48-inch Manifolds connecting pipe mains— Bissell's Point Branch.....	32,451.43
For Examining, Inspecting and Cleaning Water Mains.....	23,835.05
For Reconstruction of Steam Plant—Baden Branch.....	2,020.55
	\$576,527.46
Making a Total Net Expenditure for Operation, Maintenance, Reconstruc- tion and Extension of the Water Division—Department of Public Utili- tie, for the year, of.....	\$2,009,348.52

TABLE No. 82.

## COMMISSIONER'S OFFICE

	April	May	June	July	August	September	October	November	December	January	February	March	Total
Salaries, Wages, etc.	\$1,669.34	\$1,620.00	\$1,571.66	\$1,451.66	\$1,468.66	\$1,419.16	\$1,507.47	\$1,459.16	\$1,401.66	\$1,414.66	\$1,476.66	\$1,500.66	\$17,959.25
Record Books and Forms		17.90		77.35	18.00	113.50			73.45		8.75	147.90	456.85
Formal Reports				1,158.27									1,158.27
Other Stationery		33.05	2.20	77.40	21.50	12.15	32.60	20.20	18.15	150.44	171.95	62.80	613.79
Binding	11.35												
Repairs to Office Furniture and Fixtures													
Postage		40.00		60.00		30.00	30.00			40.00	40.00		240.00
Other Office Supplies			2.00		1.05	12.85				21.00	3.00	4.00	43.90
Car Fare	20.00					20.00			20.00		20.00		100.00
Railroad Fare and Traveling Expense													
Miscellaneous Supplies		85.20	20.35	4.00	8.00	10.58	114.27	8.13					199.47
Miscellaneous Expenses	7.15	25.80					2.15				20.50	10.00	96.16
Automobile Supplies			98.88	142.56				1.71	3.84	64.69	64.69	.50	20.50
Repairs and Replacement to Vehicles	1.25				8.00	9.75							376.87
Office Furniture and Fixtures					3.00				7.00			27.95	37.20
Total	\$1,708.09	\$1,821.95	\$1,814.34	\$2,971.24	\$1,528.21	\$1,627.99	\$1,686.49	\$1,489.20	\$1,524.10	\$1,690.29	\$1,805.55	\$1,773.81	\$21,441.26
Received for County Water Licenses													\$787.18
													\$20,654.08

## Assistant Commissioner's Office.

	April	May	June	July	August	September	October	November	December	January	February	March	Total
Salaries, Wages, etc.		\$790.00	\$1,580.00	\$1,576.33	\$1,568.71	\$1,577.83	\$1,656.65	\$1,546.50	\$1,530.00	\$1,555.00	\$1,580.00	\$1,649.92	\$16,604.94

TABLE No. 83. SUPPLY AND PURIFYING SECTION.

	April	May	June	July	August	September	October	November	December	January	February	March	Total
Salaries, Wages, etc	\$19,278.07	\$19,151.52	\$18,642.47	\$18,008.78	\$19,064.87	\$18,146.81	\$19,118.00	\$18,521.78	\$17,854.46	\$18,471.22	\$17,023.33	\$18,718.22	\$222,899.62
Board of Employees	493.77	531.06	691.25	587.28	586.65	537.61	560.50	563.83	289.13	265.00	300.25	351.00	5,757.33
Hire of Teams		57.81	312.12	22.50	48.87	23.25	189.00	197.45	218.16	203.60	218.82	189.60	1,681.18
Special Services			26.65	324.94	6.25	20.00	47.60	741.00	9.75	27.10	2.25	326.50	1,532.04
Record Books and Forms		28.95	64.75	108.85	71.00	34.15	7.10	13.75	88.85	49.00	108.70	59.20	634.30
Other Stationery													
Repairs to Office Furniture and Fixtures			2.50	3.00								23.35	29.45
Telephone Service		107.67	58.14	68.35	45.30	68.63	35.93	16.00	138.74	51.63	8.00	103.26	701.65
Postage		20.00	20.00	20.00	20.00	20.00	20.00		20.00		40.00		180.00
Other Office Expenses		15.69	6.54	20.28	5.71	7.70	18.50	6.79	9.29	67.60	16.51	13.39	188.00
Car Fare		20.00	20.00	20.00		20.00		20.00				50.00	150.00
Railroad Fare and Traveling Expenses		117.95	8.15	19.45				97.55					243.10
Freight and Express						17.01						10.00	27.01
Demurrage				16.00	45.00				42.00	22.00			125.00
Rent of Equipment													
Tools and Repairing Tools			136.90	32.35	56.67	212.49	97.78	107.55	60.92	47.09	44.00	103.09	898.84
Machinery and Equipment Parts	1.30	258.49	237.27	268.04	150.79	286.36	40.56	567.51	415.24	587.56	102.59	147.10	3,062.81
Plumbing, Heating and Steam Fitting Supplies		209.23	234.17	306.87	26.36	3.44	81.68	2.30		84.09	207.74	103.72	1,259.60
Painting and Roofing Supplies		28.00	234.60	360.52	196.25	227.13	142.30	476.57	20.00	66.10	482.59	223.25	2,457.31
Brick and Wood Blocks		59.38	22.00						26.00				107.38
Stone, Sand and Cinders			47.96	68.50								110.44	226.90
Cement and Lime		612.50							4.50		330.75		947.75
Sewer Pipe			182.37					30.72	1.52				214.61
Hardware, Steel and Iron	1.20	49.94	172.10	120.29	142.06	714.81	710.03	36.31	219.08	429.89	510.41	571.61	3,677.73
Electrical Supplies	592.36	901.16	516.89	278.26	519.26	341.07	593.51	150.02	679.90	59.87	15.47	2,106.70	6,754.47
Lumber and Timber		182.90	420.83	280.12	124.34	1,050.00	864.66	30.00	35.21	497.42		1,785.77	5,271.25
Hose and Hose Appurtenances		30.00	12.00	3.95	70.80	220.39	85.00			16.08	155.50	23.70	617.42
Surveying and Drafting Supplies					57.85				10.80		76.13		144.78
Botanical and Zoological Supplies					5.65	103.50	285.85	28.75	2.50			44.85	471.20
Miscellaneous Supplies	24.00	48.71	169.02	213.27	121.38	116.84	85.31	90.69	97.17	129.13	49.48	168.35	1,313.35
Miscellaneous Expenses		8.35	20.96	2.46	9.54	10.00		14.00		9.20	14.00	30.87	119.38
Miscellaneous Provisions		151.80								281.03	247.53	46.82	727.18
Ice				1.05	5.48	5.25	3.00	.83					15.61
Janitors' Supplies			134.00	1.00	62.43			2.25	38.00	10.80		64.10	340.18
Cleaning and Renovating							27.60						
Chemicals and Laboratory Supplies	6,922.02	16,950.97	15,533.16	14,176.49	20,764.49	23,756.60	9,225.63	13,035.10	12,857.55	14,168.67	19,173.44	22,693.34	189,257.46
Oils—Combustible			52.60	36.80	54.60	38.80	81.60	12.54	12.54	66.55		52.75	408.78

TABLE No. 83. SUPPLY AND PURIFYING SECTION—Continued.

	April	May	June	July	August	September	October	November	December	January	February	March	Total
Gas.....		\$0.60	\$0.75	\$0.91	\$4.14		\$1.51	\$1.43	\$1.66	\$2.33	\$2.48	\$2.63	\$18.44
Lubricants.....			48.38	9.24	55.97	\$52.66	13.24	9.24	.80			59.62	249.15
Machine Shop and Engine Room													
Supplies.....		5.10	3.68	92.58	6.16	57.25	130.72	79.54	5.31	7.50	186.47	7.10	581.41
Clothing and Hats.....						3.00	62.00				38.20		103.20
Boots and Shoes.....						211.83			266.40				478.23
Bedding.....								20.46					20.46
Automobile Supplies.....		128.80	4.15	6.39	48.12	4.90		2.45	47.62	148.19		80.00	470.62
Repairs and Replacement.....													
Repairs and Replacement to Structures.....								94.67				234.00	328.67
Repairs and Replacement to Vehicles											3.75	10.25	14.00
Repairs and Replacement to Main Equipment.....									21.65		371.17	2,973.10	3,411.42
Repairs and Replacements to Office Furniture and small Equipment.....		90				45.50							33.98
Household Utensils.....				134.10	86.43	14.25	14.00	6.58				26.50	639.36
Machinery and Apparatus.....			27.50		74.20			250.95	3.80	23.25	21.35	390.58	48.40
Miscellaneous Equipment.....			4.15	2.50	22.70	134.37	74.50			7.48	345.00		697.65
Special—Guard Rail Plates Sam-												149.15	394.85
gatum Switch.....							933.10						933.10
Special—Gondola Cinder Car.....			2,250.00										2,250.00
Special—Automobile.....				359.30	4,363.59	5,573.05	4,857.86	5,276.79	4,849.36	4,653.65	4,730.79	4,558.71	359.30
Special—War Protection.....		2,635.78	678.17	730.35									42,908.10
Total.....	\$27,312.72	\$42,313.26	\$40,996.18	\$37,605.46	\$46,922.91	\$52,078.65	\$38,408.07	\$40,505.40	\$38,347.91	\$40,453.03	\$44,826.70	\$56,612.72	\$506,383.01

Received from Contract and Labor Deposits.....\$ 962.05  
 Received for Material and Labor Furnished Municipal Dock.....1,521.91  
 Received for Labor Furnished—Fruin-Colnon Contr. Co. (O'Fallon St. Dock).....8.50  
 Received for Pole Rental.....92.60  
 Received for Condemned Material.....667.30  
 Receipts—Municipal Railway.....7,531.90  
 Refund—Uncollected Wages.....100.00

\$ 10,814.26  
 \$495,568.75

TABLE No. 84.  
OPERATION SECTION—CONSTRUCTION BRANCH.

	April	May	June	July	August	September	October	November	December	January	February	March	Total
Salaries, Wages, etc.	\$ 950.00	\$ 1,025.17	\$ 1,150.83	\$ 1,193.33	\$ 1,193.33	\$ 1,170.66	\$ 1,004.17	\$ 929.17	\$ 938.33	\$ 1,108.33	\$ 1,120.47	\$ 1,093.33	\$ 12,897.12
Record Books and Forms			11.00				6.75					7.75	25.50
Other Stationery			27.14		1.80	2.10					19.50	38.75	89.29
Telephone Service		19.40		19.00	9.50	9.50	9.50		19.00	9.50		19.00	114.40
Postage		20.00			20.00				20.00				60.00
Other Office Expenses		1.50	4.00			9.00				9.00	8.00	4.75	36.25
Car Fare		20.00	20.00			20.00		20.00				20.00	100.00
Railroad Fare and Traveling Expenses		236.65			193.03	93.44	109.00	94.55		158.15			884.82
Surveying and Drafting Supplies						60.45		3.10	3.90				67.45
Miscellaneous Supplies							6.50				9.00		15.50
Miscellaneous Expenses	5.00	5.00	5.00		10.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	60.00
Automobile Supplies		70.24	7.55	105.08		18.84	5.05	3.00	3.00	5.43	1.95	70.59	290.73
Repairs and Replacement													
Repairs to Vehicles						19.00							19.00
Filing Fixtures				88.50									88.50
Office Furniture and Fixtures												5.50	5.50
Machinery and Apparatus							37.50						37.50
Total	\$ 955.00	\$ 1,397.96	\$ 1,225.52	\$ 1,405.91	\$ 1,427.66	\$ 1,407.99	\$ 1,183.47	\$ 1,054.82	\$ 1,009.23	\$ 1,295.41	\$ 1,163.92	\$ 1,264.67	\$ 14,791.56

TABLE No. 85. OPERATING SECTION—CHAIN OF ROCKS BRANCH.

	April	May	June	July	August	September	October	November	December	January	February	March	Total
	\$ 6,555.82	\$ 6,915.54	\$ 7,149.93	\$ 7,165.71	\$ 7,149.65	\$ 6,972.63	\$ 6,856.46	\$ 6,902.37	\$ 6,943.36	\$ 7,052.35	\$ 6,796.95	\$ 7,086.41	\$ 83,607.18
Salaries and Wages, etc.		190.16	81.75	153.89	103.41		347.54	157.16	220.40	178.46	172.58	197.86	1,803.21
Piece Work			6.50	4.00		56.56						101.00	168.06
Record Books and Forms			8.00									12.00	20.00
Other Stationery			33.50	9.50	9.50	33.50	9.50		43.00	9.50	3.00	19.00	210.00
Telephone Service		43.00										108.00	283.00
Demurrage		182.00											
Rent of Equipment			19.25	47.65	130.90	14.16	130.49	49.78	94.71	3.45	.90	94.69	575.98
Tools and Repairing Tools			275.37	183.45	210.22	215.50	450.03	313.90	228.66	135.92	48.86	314.43	2,972.01
Machinery and Apparatus	26.58	569.09											
Plumbing, Heating and Steam Fitting Supplies			501.51	983.84	236.56	784.12	487.41	45.82	416.30	289.39	15.84	1,936.19	5,696.98
Painting and Roofing Supplies			5.88	77.75	.45	17.85					7.50		130.06
Brick and Wood Blocks			132.50	20.00						20.63			132.50
Hardware, Steel and Iron	60.33		112.90	204.44	144.45	214.14	15.83	91.56	45.09	206.66	8.00	551.01	1,654.41
Electrical Supplies									44.80				44.80
Lumber and Timber						16.25							16.25
Hose and Hose Appearances			25.83	15.59	28.20	2.88	10.00	3.50	81.45	12.00		12.42	191.87
Miscellaneous Supplies			7.00					7.00					14.00
Miscellaneous Expenses													
Ice			9.80	59.80			21.25			9.80	21.25		121.90
Soap			42.80			19.68	12.70		62.10			23.90	161.18
Janitors' Supplies													
Other Medical and Surgical Supplies	218.40	4,228.21	3,817.83	2,474.03	3,698.03	8,660.72	4,322.68	4,701.40	6,517.49	7,674.76	7,064.80	7,764.99	19,56
Fuel			Coal										61,143.34
Coke and Charcoal				52.60		38.80	40.80				34.10	40.80	207.10
Oils—Combustible			138.74	240.30	263.52	252.49	237.02			107.94		335.96	1,717.05
Lubricants	25.66												
Machine Shop and Engine Room Supplies			114.92	32.48	844.89	177.14	15.74	121.03	51.65	493.50	328.70	365.39	2,545.44
Clothing and Hats													
Boots and Shoes			48.86									16.00	64.86
Toweling													
Repairs and Replacements													
Repairs to Main Equipment													
Repairs to Supplies and Small Equipment					25.40								25.40
Filing Fixtures													
Office Furniture and Fixtures			12.00			300.00							12.00
Machinery and Apparatus													300.00
Miscellaneous Equipment			1.50	1.70	7.00							11.25	21.45
Special Impellers for Pumps Nos. 4 and 5									204.00	204.80			408.80
Hydraulic Cylinder Screen House													
Brass Tubes—Condensers—Engines Nos. 6, 7, 8, 9													
Total	\$ 6,861.13	\$12,133.66	\$12,546.37	\$11,726.73	\$12,832.18	\$17,776.42	\$12,906.65	\$12,609.74	\$14,953.01	\$16,399.16	\$14,502.48	\$19,010.86	\$164,298.39
Received for Condemned Material													\$ 530.00
													\$163,768.39



TABLE No. 87. OPERATING SECTION—BISSELL'S POINT BRANCH.

	April	May	June	July	August	September	October	November	December	January	February	March	Total
Salaries, Wages, etc.	\$ 7,241.41	\$ 7,646.49	\$ 7,801.75	\$ 8,512.26	\$ 8,412.85	\$ 7,778.95	\$ 7,816.54	\$ 7,515.97	\$ 7,605.30	\$ 7,726.62	\$ 7,461.11	\$ 7,627.90	\$ 93,147.15
Piece Work.		163.70	91.98	105.90	110.26		241.09	156.87	159.80	230.90	193.92	203.46	1,637.88
Record Books and Forms.			62.60	14.75				4.25	34.40			76.80	192.80
Other Office Expenses.													
Demurrage		48.00											48.00
Rent of Equipment.													
Tools and Repairing Tools.		22.55	144.15	18.13	25.91	7.00	67.65	66.59	78.73	34.40	26.37	157.07	648.55
Machinery and Equipment Parts.		131.75	71.83	69.58	92.87	229.41	176.19	112.36	141.68	316.18	100.22	552.92	2,109.24
Plumbing, Heating and Steam Fitting Supplies.		80.74	711.84	1,010.46	1,074.44	208.44	2.00	90.24	233.13	94.54	310.44	337.73	4,154.00
Painting and Roofing Supplies.			47.40				18.55		33.03	21.25			131.63
Brick and Wood Blocks.		160.75	132.00										105.00
Hardware Steel and Iron.	8.80	40.65	68.73	71.79	92.07	41.86	181.93	116.48	89.23	240.69	118.64	75.23	397.75
Electrical Supplies.			32.50							65			1,146.10
Hose and Hose Appurtenances.			6.12	38.40	8.00	37.00		26.10				8.00	33.15
Miscellaneous Supplies.			53.49	36.90			1.44	24.34	26.90	13.50	21.60	17.15	195.32
Miscellaneous Expenses.								2.50					2.50
Ice.													
Soap.			92.25				23.10				30.80		146.15
Janitors' Supplies.			107.00	89.13	56.00		5.83				5.60	20.25	283.81
Other Medical and Surgical Supplies.							6.35						6.35
Coal.	2,602.12	2,475.87	2,151.13	2,888.41	3,738.13	7,921.99	3,407.37	5,015.77	4,831.18	5,559.04	7,134.99	6,978.06	54,704.06
Coke and Charcoal.			52.60				38.80	25.36		40.80	70.55	19.80	275.66
Lubricants.	63.44		150.63	249.19	202.50	18.59	279.78	60.20		121.29	147.89		1,293.51
Machine Shop and Engine Room Supplies.		195.67	33.10		79.96	66.95	59.48	2.19	426.46	64.06	15.24	282.28	1,225.39
Clothing and Hats.													
Boots and Shoes.													
Repairs and Replacements.													
Repairs to Main Equipment.													
Repairs to Supplies and Small Equipment.	62.50		6.50								20.00		89.00
Office Furniture and Fixtures.			6.63	60.00	31.10					14.03			45.13
Machinery and Apparatus.					16.50								83.13
Miscellaneous Equipment.			3.70		3.70				70.00				73.70
Special Super-Heaters and Check Valve Boilers, 1-2-3-4.		34.25	48.50		2.50	18.35							103.60
Conveyor for Coal Storage Shed.													
Steel Bins—Store Room.								1,100.00				887.20	1,116.55
												16.55	1,116.55
												437.50	437.50
Total.	\$10,092.92	\$10,770.50	\$12,014.55	\$13,253.00	\$13,926.59	\$16,387.54	\$12,315.05	\$14,319.22	\$13,729.84	\$14,477.95	\$15,657.37	\$17,813.90	\$164,758.43

Received for Condemned Material.

Refund on account uncollected wages.

\$4,678.80

4.69

\$ 4,683.49

\$160,074.94

TABLE No. 88. OPERATING SECTION—SANITARIUM BRANCH.

	April	May	June	July	August	September	October	November	December	January	February	March	Total
Salaries, Wages, etc.	\$ 3,158.40	\$ 3,316.82	\$ 3,386.65	\$ 3,407.33	\$ 3,461.16	\$ 3,377.64	\$ 3,451.01	\$ 3,432.81	\$ 3,431.42	\$ 3,535.09	\$ 3,421.35	\$ 3,503.29	\$ 40,882.97
Piece Work	161.08	119.22	103.02	55.81	78.23	30.50	98.48	256.15	294.71	3.90	516.70	227.17	1,914.47
Record Books and Forms				5.45	4.00	8.15	81.5	4.25	2.75		6.65	8.09	43.40
Other Stationery				8.15	8.15				16.30	8.15		16.30	16.29
Telephone Service		16.72	8.15										98.22
Demurrage													
Rent of Equipment													
Tools and Repairing Tools			20.60	17.43		12.45	7.80	.60		30.30	4.35	111.40	204.93
Machinery and Equipment Parts		20.28			18.48	314.35	40.50	2.80			13.09	82.27	491.77
Plumbing, Heating and Steam				23.34	4.36	345.45	66.32	127.49	113.89	11.30	51.64	244.85	1,299.01
Fitting Supplies		16.30	40.37	1.63		2.80	3.05						30.53
Painting and Roofing Supplies			6.75										67.00
Brick and Wood Blocks			28.08			2.38	21.58				56.00	11.00	122.61
Hardware, Steel and Iron			7.20	48.03	8.25	4.00	13.50	3.97			19.69	2.85	71.26
Electrical Supplies										11.90		34.34	11.90
Lumber and Timber							1.77						17.53
Hose and Hose Apparatus			12.00	4.35	6.25	64.90	12.00	8.50	17.25	3.00	98.36	4.35	230.96
Miscellaneous Supplies							5.00		2.50				7.50
Miscellaneous Expenses								13.20			11.25		36.85
Soap		3.60		8.80									43.71
Janitors' Supplies		2.00	19.00	4.13	5.45						9.75	3.38	54,903.95
Coal	2,781.72	1,772.07	1,401.90	630.75	1,135.69	5,712.93	3,676.10	7,809.17	6,586.43	9,176.96	8,204.53	6,017.70	16,200
Coke and Charcoal				16.20									29.60
Oils—Combustible		3.95		9.20									557.45
Lubricants		58.96	58.96	40.48	58.59	40.48	62.64	70.86	44.48	58.79	4.25	58.96	426.18
Machine Shop and Engine Room													14.72
Supplies			29.94	31.32	22.28	101.32	1.75	72.00	13.90		37.56	116.11	18.44
Clothing and Hats									14.72				9.75
Boots and Shoes													18.18
Repairs and Replacements								18.44					32.95
Repairs to Main Equipment													
Repairs to Supplies and Small					9.75								
Equipment			10.00								3.00		
Machinery and Apparatus													
Miscellaneous Equipment			4.00			1.95							
Total	\$ 6,101.20	\$ 5,329.92	\$ 5,136.62	\$ 4,582.40	\$ 4,820.64	\$ 10,021.07	\$ 7,483.64	\$ 11,820.24	\$ 10,553.73	\$ 12,872.64	\$ 12,458.17	\$ 10,442.06	\$ 101,622.33

TABLE No. 89. DISTRIBUTION SECTION—STREET SERVICE BRANCH.

	April	May	June	July	August	September	October	November	December	January	February	March	Total
Salaries, Wages, etc.	\$18,903.40	\$19,922.12	\$20,605.01	\$20,793.44	\$20,101.56	\$18,773.46	\$19,038.98	\$19,007.24	\$17,851.15	\$17,609.42	\$17,657.67	\$18,909.62	\$229,173.07
Hire of Teams	66.00	78.00	75.00	63.00	47.00								282.00
Special Services				39.05	31.50		34.00	66.70			46.75	14.50	47.00
Record Books and Forms		20.75	134.10		23.40	39.75	11.00	21.35	8.00	27.60	11.20	52.00	387.35
Other Stationery		45.95	33.50	2.75									276.50
Repairs to Office Furniture and Fixtures					2.50								2.50
Telephone Service		154.10	136.60	17.50	17.50	138.10	17.50		155.60	17.50		35.00	689.40
Postage		40.00		40.00		30.00	20.00		30.00	30.00	40.00		230.00
Other Office Expenses			4.50	12.00	2.25	100.20			100.00	50.00			247.95
Car Fare		50.00	50.00	50.00	50.00	50.00					50.00		500.00
Railroad Fare and Traveling Expenses		107.75			101.70		299.45	159.40	287.33	269.23	307.30	281.12	1,813.28
Dumpage and Storage													
Freight and Express													
Demurrage													
Tools and Repairing Tools		39.35	119.46	63.65	34.77	30.88	3.17	105.24	19.50	8.64	91.21	363.44	879.31
Machinery and Equipment Parts		25.08		22.58	147.05	57.44	18.10		.88	75.41	1.51	9.20	357.25
Plumbing, Heating and Steam Fitting Supplies		43.65			26.87	532.21		8.68					
Painting and Roofing Supplies		11.00		13.50	52.33	1.45		26.93	20.90	.80	16.45	1,161.17	1,772.58
Brick and Wood Block													143.36
Stone, Sand and Cinders													475.00
Cement and Lime													716.56
Sewer Pipe			24.15										735.00
Water Pipe			146.13	94.33	337.35	161.96	550.55	45.58	115.68	62.33	272.51	237.85	86.48
Hardware, Steel and Iron		111.78	409.57	87.66	79.87	101.01	79.47	677.08		6.95	345.10		2,080.67
Lumber and Timber					1.70				5.00	450.00			2,229.76
Hose and Hose Appurtenances		315.45	84.90	699.50			482.55	282.50		254.70	69.50	178.50	2,554.70
Surveying and Drafting Supplies		9.00	3.25	90.33	17.35	3.00	10.17	.68	503.34	3.13	2.60	787.20	3,158.04
Miscellaneous Supplies		7.50	3.00							14.55	17.72		151.63
Miscellaneous Expenses												3.00	31.05
Ice				52.20	91.20	83.10	47.21	3.75				9.80	277.46
Soap				13.72									23.52
Janitors' Supplies			20.74	9.40	7.50	7.00		4.70			13.00		62.34
Coal													
Oils—Combustible			39.51			39.91	44.53			49.51	49.52	49.51	272.49
Gas		4.20		.75	.15	.30		4.06	4.73	14.46	13.21	68.87	68.89
Electrical Current		12.04	5.21	5.06	4.35	3.64	4.12	4.47	5.25	4.73	4.28	8.37	61.52
Lubricants						11.12							11.12
Machine Shop and Engine Room Supplies		34.53					45.45	15.19		17.85			113.02
Boots and Shoes						14.25	21.00	16.65		277.56	30.00		359.46
Shoeing and Clipping Horses		229.25	188.75	145.75	157.65	158.80	163.10	125.25	176.60	169.95	144.50	140.05	1,799.65

TABLE No. 89. DISTRIBUTION SECTION—STREET SERVICE BRANCH—Continued.

	April	May	June	July	August	September	October	November	December	January	February	March	Total
Grains.....		\$829.35	\$398.85	\$395.64	\$430.09	\$397.83	\$390.86	\$511.40	\$301.98	\$554.14	\$564.26	\$946.54	\$5,720.94
Fodder and Bedding.....		178.48	52.63	273.28	225.32	143.02		237.71	140.06	321.24	348.28	542.63	2,462.65
Harness Supplies.....													
Veterinary Supplies.....		17.75	38.00	9.00		4.00				5.00	4.75	20.70	99.20
Automobile Supplies.....		114.85		7.00	140.27	71.90	377.80	83.85	82.00	25.63	35.56	259.53	1,198.39
Miscellaneous Stable Supplies and Expenses.....			5.00										
Repairs and Replacements to Structures.....											46.50		51.50
Repairs and Replacements to Vehicles.....		110.00					1.69		8.25				119.94
Repairs and Replacements to Main Equipment.....		143.50	78.00	86.40	8.00	64.68	151.60	57.75	24.20	28.10	58.85	122.90	823.98
Repairs and Replacements to Supplies and Small Equipment.....							9.60	13.68					23.28
Filing Fixtures.....		60.77	58.25	51.85	26.20	51.45	23.65	15.75	11.35	6.75	8.25	16.00	330.27
Office Furniture and Fixtures.....					76.78	24.00							100.78
Machinery and Apparatus.....					11.00				.60		31.00		42.60
Live Stock.....			670.00										670.00
Miscellaneous Equipment.....		16.00	142.50	16.90	45.50	1.85	5.25	39.65	9.82		24.00		301.47
Other Vehicles.....				117.50		675.00							792.50
Special—Motor Trucks.....			359.25	2,765.00	199.90								3,324.15
Special—Repairs to Paved Streets.....		391.22	417.39	74.16	159.96	85.45	202.86	3,147.51	260.30	384.42	117.20		5,240.47
Special—Pitometer.....								605.86					605.86
Gate House—Compton Hill.....						184.56	233.70	963.83	530.42	122.33			2,034.84
Total.....	\$18,969.40	\$23,123.42	\$24,306.70	\$26,112.90	\$22,658.57	\$22,041.32	\$22,288.27	\$26,252.44	\$20,652.94	\$20,736.23	\$20,422.68	\$26,147.86	\$273,712.73

Received for Contract and Other Deposits..... \$26,710.68  
 Received for Work Done for Department of Streets and Sewers..... 8,636.50  
 Received for Work Done for Department of Parks and Recreation..... 574.65  
 Received for Work Done for City Plan Commission..... 44.19  
 Received for Condemned Material..... 3,283.30  
 Received for Miscellaneous Work..... 162.00  
 Returned Uncollected Wages..... 69.88  
 \$ 39,481.20  
 \$234,231.53

TABLE No. 90. DISTRIBUTION SECTION—METER AND TAP BRANCH.

	April	May	June	July	August	September	October	November	December	January	February	March	Total
Salaries, Wages, etc.....	\$ 1,859.00	\$ 2,018.00	\$ 2,195.00	\$ 2,309.00	\$ 2,315.00	\$ 2,273.00	\$ 2,266.81	\$ 2,242.25	\$ 2,024.92	\$ 1,939.00	\$ 1,840.00	\$ 1,861.00	\$ 25,142.98
Record Books and Forms.....	8.50	8.50				18.75				20.25	17.00	13.75	78.25
Other Stationery.....	6.50	20.00		19.82		20.00			8.00				34.32
Postage.....						35.00			20.00	20.00			80.00
Other Office Expenses.....		1.50		18.00						33.00			87.50
Car Fare.....		20.00			30.00							50.00	100.00
Railroad Fare and Traveling Expenses.....													
Freight and Express.....													
Tools and Repairing Tools.....					57.79		17.90	9.80	2.30	4.25	118.75	1.00	211.79
Machinery and Equipment Parts.....		45.28		288.51	170.75	51.60	178.55	211.35	20.47		167.86	313.37	1,447.74
Plumbing, Heating and Steam Fitting Supplies.....													
Water Pipes and Valves.....	209.85	211.32	424.06		484.27	169.74	35.32	60.98	154.44	68.23	158.99	915.20	2,824.08
Hardware, Steel and Iron.....		57.60	17.12			57.60				47.69	55.70		183.43
Electrical Supplies.....	3.36					5.04		3.24	4.88	43.92	5.50		120.51
Lumber and Timber.....													65.94
Miscellaneous Supplies.....	38.00	17.83	29.50		4.58	28.04	25.45	11.90	14.21	13.00	99.20	15.00	99.20
Miscellaneous Expenses.....		2.00			23.00					2.00	47.10	3.50	244.61
Janitors' Supplies.....									12.25	16.50			32.50
Oils—Combustible.....						19.40							28.75
Gas.....	.08	.08			.08	.08		.38	.08	.08	.23	.53	19.40
Machine Shop and Engine Room Supplies.....			4.53			12.86		3.27		17.59	18.75		57.00
Boots and Shoes.....	56.00		45.25		35.45	90.00		5.55					95.55
Shoeing and Clipping Horses.....				26.75		35.70	27.60	35.05	32.80	33.40	21.90		349.90
Grains.....	28.56	18.36	22.40	22.40		22.40	26.82		152.60	31.50		274.95	573.59
Fodder and Bedding.....	181.63	18.70	48.10			46.44	267.56		163.05	3.00		149.67	878.15
Harness Supplies.....													
Automobile Supplies.....	75.23		186.12				153.77	2.10	96.85	33.98		211.05	757.10
Miscellaneous Stable Supplies and Expenses.....									16.50				16.50
Repairs and Replacements to Vehicles.....	10.15	35.50	13.30		33.60	3.00	40.00	42.45	35.00	13.95	5.25	10.85	243.05
Repairs and Replacements to Supplies and Small Equipment.....	24.00	4.60	7.35		15.60	16.85	4.00			15.50	31.20	18.40	137.50
Machinery and Apparatus.....													
Live Stock.....		485.00											485.00
Miscellaneous Equipment.....					39.25	72.80	9.50					62.00	183.55
Other Vehicles.....													
Special—Ford Motor Vehicles.....		359.30		738.57	14.90								1,112.77
Special—Ventura Meter and Equipment.....													
Special Purchase of Water Meters.....						75.00	8,035.00	1,016.00		923.00		1,650.00	11,699.00
Total.....	\$ 1,859.00	\$ 2,677.86	\$ 3,517.32	\$ 4,153.13	\$ 3,226.27	\$ 3,053.30	\$11,084.28	\$ 3,644.32	\$ 2,758.35	\$ 3,279.84	\$ 2,587.34	\$ 5,550.27	\$ 47,

TABLE No. 91.  
DISTRIBUTION SECTION—INSPECTION BRANCH.

	April	May	June	July	August	September	October	November	December	January	February	March	Total
Salaries, Wages, etc.....	\$ 3,074.75	\$ 3,305.92	\$ 3,535.00	\$ 3,617.65	\$ 3,622.50	\$ 3,672.10	\$ 3,633.39	\$ 3,640.00	\$ 3,660.00	\$ 3,660.00	\$ 3,681.43	\$ 3,660.00	\$ 42,762.74
Record Books and Forms.....				17.35		16.75			19.20				53.30
Other Stationery.....		17.40					38.45	3.00			66.90		125.75
Repairs to Office Furniture and Fixtures.....													
Telephone Service.....		19.50	19.50			19.50			19.50				78.00
Postage.....		60.00		40.00			60.00		30.00	30.00	50.00		270.00
Other Office Expenses.....						38.60				9.00			47.60
Car Fare.....		100.00	100.00	100.00	100.00	100.00			200.00	200.00	100.00	200.00	1,200.00
Miscellaneous Supplies.....		5.72						24.00					29.72
Automobile Supplies.....				40.30							4.42	47.45	92.17
Repairs and Replacements.....													
Repairs to Vehicle.....													
Office Furniture and Fixtures.....										75.00			75.00
Total.....	\$ 3,074.75	\$ 3,508.54	\$ 3,654.50	\$ 3,815.30	\$ 3,722.50	\$ 3,846.95	\$ 3,731.84	\$ 3,667.00	\$ 3,928.70	\$ 3,974.00	\$ 3,902.75	\$ 3,907.45	\$ 44,734.28

TABLE No. 92. ASSESSMENT SECTION.

	April	May	June	July	August	September	October	November	December	January	February	March	Total
Salaries, Wages, etc.....					\$ 5,295.91	\$ 5,283.33	\$ 5,204.94	\$ 5,313.33	\$ 5,273.01	\$ 5,193.17	\$ 5,288.33	\$ 5,217.36	\$ 62,434.39
Record Books and Forms.....	\$ 4,870.70	\$ 5,010.55	\$5,219.33	\$ 5,264.33	498.90	439.35	181.55	310.75	285.80	433.00	63.20	701.35	3,792.75
Other Stationery.....		389.05	237.60	279.20	17.50	50.00	89.88	22.04	41.25	4.20	223.43	32.35	496.13
Binding.....		6.25	.55	8.75	84.00							292.75	376.75
Repairs to Office Furniture and Fixtures.....													
Postage.....	20.00	50.00	50.00	50.00	50.00	50.00	60.00	60.00	60.00	75.00	75.00		600.00
Other Office Expenses.....		38.25	71.50	71.50	2.25	38.60	36.00	2.25		90.00	2.25	10.00	291.10
Car Fare.....		200.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	200.00		1,200.00
Electrical Supplies.....		6.48		9.28			4.58	5.28			6.48	28.34	60.44
Miscellaneous Supplies.....					.75	3.25	8.40		6.00		8.26	9.00	52.28
Automobile Supplies.....			16.62	1.91		5.10	146.21	147.52	28.00	14.10	8.84	126.69	478.37
Repairs and Replacements to Vehicles.....										15.25			15.25
Filing Fixtures.....							35.00						35.00
Office Furniture and Fixtures.....					14.90	32.00					16.64		16.64
Special—Automobiles.....			1,076.62	403.37									1,526.89
Total.....	\$ 4,890.70	\$ 5,700.58	\$ 6,700.72	\$ 6,188.34	\$ 6,064.21	\$ 6,001.63	\$ 5,866.56	\$ 5,961.20	\$ 5,767.06	\$ 5,924.72	\$ 5,892.43	\$ 6,417.74	\$ 71,375.89

TABLE No. 93. WATER WORKS EXTENSION, RECONSTRUCTION, ETC., CONTRACTS.

Influence Number	Appropriation	DESCRIPTION OF CONTRACT	CONTRACTOR	Number of Contract	Amount of Contract	Expended Previous Report, 1916-1917	Expended Since Last Report, 1916-1917	Total Expended	Expended on Extension, Reconstruction, etc., 1917-1918	Balances	
										Transferred	Not Transferred, Available
26927 Sec. 2	\$675,000.00	Construction of Filters.....	McCormack-Combs Const. Co.....	*10,221	\$225,023.70	\$249,303.71		\$249,303.71			
		Construction of Filter Equipment.....	Pittsburg Filter Mfg. Co. . .	*10,231	398,200.00	399,574.97		399,574.97		\$ 718.31	
		Construction of Concrete Division Wall.....	Hogan Contracting Co. . .	*10,527	21,785.00	21,983.01		21,983.01			
		Miscellaneous.....	Miscellaneous.....			3,000.00	\$ 420.00	3,420.00	\$ 420.00		
27111	\$175,000.00	Retracement of East Bank of Mississippi River.....	J. W. McMurry Const. Co. . .	*10,271	\$167,430.00	\$173,393.59		\$173,393.59			\$ 918.55
		Miscellaneous.....	Miscellaneous.....			687.86		687.86			
27411 and 27742	\$205,000.00	Erection of Head House.....	McCormack-Combs Const. Co. . .	*10,493	\$ 96,585.60	\$114,994.91		\$114,994.91			
		Miscellaneous.....	Miscellaneous.....	*10,477	5,298.00	4,985.37		4,985.37			
		Erection of Chimneys.....	John V. Bolland Const. Co. . .	*10,477	5,298.00	5,298.00		5,298.00			
		Installing Pumps and Motors.....	Works.....	*10,612	9,485.00	9,537.05		9,537.05			
		Chemical Storage and Reclaiming Equipment.....	Link Belt Co. . .	*10,500	3,700.00	3,784.40		3,784.40			
		Steam Heating Plant.....	Modern Heating Co. . .	*10,478	18,666.00	18,892.02		18,892.02			
		Installation of Boilers.....	Ruemmel-Dawley Mfg. Co. . .	*10,479	7,425.00	7,560.65		7,560.65		\$ 6,147.62	
		Piping.....	Urbaner-Atwood Heating Co. . .	*10,579	11,500.00	11,816.12		11,816.12			
		Miscellaneous.....	Miscellaneous.....	*10,650	14,685.00	14,585.19		14,585.19			
		Meters, Controllers, etc.....	Pittsburgh Filter Mfg. Co. . .	*10,650	14,685.00	14,585.19		14,585.19			
		Miscellaneous.....	Miscellaneous.....	*10,480	3,397.00	331.60		331.60			
		Ice Plant.....	J. F. Menard.....	*10,480	3,397.00	3,397.00		3,397.00			
27117	\$ 60,000.00	Gauges, Agitators, etc.....	Miscellaneous.....			2,506.31		2,506.31			
		Chain Grate Stokers.....	Laclede-Christy Clay Products Co. . .	*10,494	\$ 10,998.00	\$ 9,776.70	\$ 1,158.81	\$ 10,935.51	\$ 1,158.81		
		Miscellaneous.....	Miscellaneous.....	*10,449	26,770.00	445.49		445.49			
		Conveying Machinery, etc.....	Stephens-Adamson Mfg. Co. . .	*10,449	26,770.00	26,943.59		26,943.59			
		Miscellaneous.....	Miscellaneous.....			4,979.63		4,979.63		\$ 2,049.60	
		Excavation and Concrete Removal of Dwindraft Furnaces.....	Miscellaneous.....			11,019.79		11,019.79			
		Brick Work.....	Miscellaneous.....			1,149.38		1,149.38			
			Miscellaneous.....			2,467.01		2,467.01			



TABLE No. 94. WATER PIPE DISTRIBUTION AND OTHER CONTRACTS.

Ordinance Number	Appropriation	DESCRIPTION OF CONTRACT	CONTRACTOR	Number of Contract	Amount of Contract	Expended Previous to Last Report, 1916-1917	Expended Since Last Report, 1916-1917	Total Expended	Expended on Pipe Distribution, 1917-1918	Balances	
										Transferred	Not Transferred, Available
27791	\$ 80,000.00	Water Pipe.....	U. S. Cast Iron Pipe and Foundry Co.....	*10,572	\$ 22,750.00	\$ 27,078.06		\$ 27,078.06			
		Stop Valves.....	A. P. Smith Mfg. Co.....	*10,575	3,580.00	3,614.90		3,614.90			
		Fire Hydrants.....	Kennedy Valve Mfg. Co.....	*10,576	12,027.50	12,764.25		12,764.25			\$ 7,385.78
		Special Castings.....	Bessemer Foundry & Machine Co.....								
		Miscellaneous.....	Miscellaneous.....	*10,573	11,296.80	11,059.27		11,059.27			
						16,626.74	\$ 1,471.00	18,097.74	\$ 1,471.00		
27971	\$115,000.00	Water Pipe.....	U. S. Cast Iron Pipe & Foundry Co.....	*10,812	\$ 59,525.75	\$ 60,240.52		\$ 60,240.52			
		Stop Valves.....	A. P. Smith Mfg. Co.....	*10,814	5,806.25	5,868.90		5,868.90			
		Special Castings.....	Bessemer Foundry and Machine Co.....	*10,813	15,260.00	16,920.76		16,920.76			\$ 3,327.33
		Fire Hydrants.....	Kennedy Valve Mfg. Co.....	*10,815	19,734.50	19,754.50		19,754.50			
		Miscellaneous.....	Miscellaneous.....			8,887.99		8,887.99			
27972	\$ 35,000.00	Laying Water Pipe.....	Napoleon B. Watters.....	*10,822	\$ 15,160.26	\$ 15,494.24		\$ 15,494.24			
		Miscellaneous.....	Miscellaneous.....			6,711.10		19,505.76	\$ 12,794.66		
28424	\$272,000.00	Water Pipe.....	East Jersey Pipe Corporation.....	*11,036	\$193,680.00	\$192,623.54		\$192,623.54			
		Laying Water Pipe.....	Inland Construction Co.....	*11,040	49,481.32	46,281.59		60,572.21	\$ 14,290.62		
		Miscellaneous.....	Miscellaneous.....			12,617.45		18,804.25	6,186.80		
28841	\$125,000.00	Water Pipe.....	U. S. Cast Iron Pipe & Foundry Co.....	*11,108	\$ 53,910.00	\$ 52,857.56		\$ 52,857.56			
		Special Castings.....	Bessemer Foundry & Machine Co.....	*11,109	13,419.00	12,452.83		3,943.34	3,943.34		
		Stop Valves.....	A. P. Smith Mfg. Co.....	*11,110	4,494.25	315.00		4,563.65	4,248.65		\$ 9,282.32
		Fire Hydrants.....	A. P. Smith Mfg. Co.....	*11,111	10,297.50	3,445.20		10,322.85	6,877.65		
		Miscellaneous.....	Miscellaneous.....			13,607.02		31,577.45	17,970.43		
29690	\$ 50,000.00	Examining, Inspecting and Cleaning Water Pipes.....	National Water Main Cleaning Co.....	11,344	\$ 49,850.00			\$ 23,835.05	\$ 23,835.05		\$ 26,164.95
29796	\$160,000.00	Water Pipe.....	American Cast Iron Pipe & Foundry Co.....	Reg. 1561				\$ 60,011.12	\$ 60,011.12		
		Special Castings.....	Bessemer Foundry & Machine Co.....	Reg. 1557-59				30,185.13	30,185.13		\$ 46,225.12
		Fire Hydrants.....	American Foundry & Manufacturing Co.....	Reg. 1558				20,671.05	20,671.05		
		Miscellaneous.....	Miscellaneous.....					2,907.58	2,907.58		

\* Completed.

Total expended for Pipe Distribution from April 1, 1917, to April 1, 1918.

Total expended for Examining, Inspecting and Cleaning Water Pipe.

\$181,558.03

23,835.05

TABLE No. 95. WATER DIVISION FUND.

<b>Appropriated by—</b>		
Ordinance No. 29,660—Commissioner's Office.....	\$ 28,250.00	
Ordinance No. 29,660—Assistant Commissioner's Office.....	22,200.00	
Ordinance No. 29,660—Distribution Section—Street Service Branch.....	\$275,380.00	
Ordinance No. 29,924—Distribution Section—Street Service Branch.....	2,000.00	277,380.00
Ordinance No. 29,660—Operating Section—Baden Branch.....	159,581.00	
Ordinance No. 29,924—Operating Section—Baden Branch.....	16,425.00	176,006.00
Ordinance No. 29,660—Operating Section—Bissell's Point Branch.....	154,355.00	
Ordinance No. 29,924—Operating Section—Bissell's Point Branch.....	27,050.00	181,405.00
Ordinance No. 29,660—Operating Section—Chain of Rocks Branch.....	149,091.00	
Ordinance No. 29,924—Operating Section—Chain of Rocks Branch.....	23,775.00	172,866.00
Ordinance No. 29,660—Operating Section—Sanitarium Branch.....	83,633.00	
Ordinance No. 29,924—Operating Section—Sanitarium Branch.....	31,350.00	114,983.00
Ordinance No. 29,660—Distribution Section—Meter and Tap Branch.....	40,860.00	
Ordinance No. 29,924—Distribution Section—Meter and Tap Branch.....	500.00	41,360.00
Ordinance No. 29,660—Distribution Section—Inspection Branch.....		47,660.00
Ordinance No. 29,660—Operating Section—Construction Branch.....		17,080.00
Ordinance No. 29,660—Supply and Purifying Section.....	477,647.00	
Ordinance No. 29,924—Supply and Purifying Section.....	23,305.00	500,952.00
Ordinance No. 29,660—Assessment Section.....		80,760.00
Ordinance No. 29,660—Distribution Section—Street Service Branch.....		
Special Account—Purchase of Motor Trucks, etc..	65,700.00	
Transferred to Ordinance No. 29,690—Cleaning		
Water Mains.....	50,000.00	15,700.00
Ordinance No. 29,660—Operating Section—Bissell's Point Branch—Special		
Account—Purchase of Superheaters, Check		
Valves, etc.....		10,525.00
Ordinance No. 29,660—Operating Section—Chain of Rocks Branch—		
Special Account—Purchase of Impellers, etc..		5,200.00
Ordinance No. 29,660—Distribution Section—Meter and Tap Branch—		
Special Account—Purchase of Water Meters,		
etc.....		17,100.00
Ordinance No. 29,660—Supply and Purifying Section—Special Account—		
War Protection, etc.....	74,400.00	
Ordinance No. 29,924—Purchase of Passenger Car.....	15,000.00	89,400.00
Ordinance No. 29,660—Assessment Section—Special Account—Purchase of		
Automobiles, etc.....		3,100.00
		\$1,801,927.00
Transferred from Contract and other Deposits to		
Distribution Section, Street Service Branch,		
for doing private work.....	26,710.68	
Transferred from City Plan Commission to Distribu-		
tion Section, Street Service Branch, for work		
done.....	44.19	
Transferred from Division of Parks and Recreation-		
Zoological Gardens to Distribution Section,		
Street Service Branch, for work done.....	574.65	
Transferred from Division of Streets and Sewers,		
Office of Director and Commissioner to Dis-		
tribution Section, Street Service Branch, for		
work done.....	11.96	
Transferred from Contract and Other Deposits to		
Supply and Purifying Section for work done..	962.05	
Transferred from Municipal Dock, Ordinance No.		
28,435, to Supply and Purifying Section, for		
work done.....	1,521.91	29,825.44
		\$1,831,752.44

TABLE No. 95. WATER DIVISION FUND—Continued.

Total Brought Forward .....		\$1,831,752.44
Amount refunded Distribution Section, Street Service Branch, from Contract and Other Deposits for doing private work.....	\$ 26,710.68	
Amount refunded Distribution Section, Street Service, Branch, from City Plan Commission, for work done.....	44.19	
Amount refunded Distribution Section, Street Service Branch, from Division of Parks and Recreation-Zoological Gardens, for work done.....	574.65	
Amount refunded Distribution Section, Street Service Branch, from Division of Streets and Sewers—Office Director and Commissioner, for work done.....	11.96	
Amount refunded Supply and Purifying Section from Contract and other Deposits for doing private work.....	962.05	
Amount refunded Supply and Purifying Section from Municipal Dock for work done.....	1,521.91	
Amount transferred to Revenue by Distribution Section, Street Service Branch, from Division of Streets and Sewers for work done.....	8,624.54	
Amount transferred to Revenue by Supply and Purifying Section for Labor furnished—Fruin & Colnon Contr. (O'Fallon Street Dock).....	8.50	
Amount received for County Water Licenses.....	787.18	
Amount received for Ground and Pole rental.....	22.60	
Amount received by Collector of Water Rates for material and labor furnished on Taps, etc.....	3,733.45	
Amount received by Collector of Water Rates for miscellaneous work.....	162.00	
Amount received for Condemned Material.....	9,225.40	
Amount received for Cash Fares and sale of car tickets Municipal Railway.....	7,531.90	
Amount transferred to Revenue—Account unpaid payrolls, etc.....	194.57	
	\$ 60,115.58	
Cost of Heat, Light, Power and Refrigeration—Sanitarium, Infirmary and Infectious Hospital.....	94,102.29	
Cost of Labor and Material furnished Power Plants—Department of Public Utilities.....	1,367.95	
Cost of Labor and Material furnished other Departments.....	4,205.47	
	\$159,791.29	
Transferred back to Revenue.....	239,140.09	\$ 398,931.38
Net Cost of Operation and Maintenance of Water Division for year ending April 1, 1918.....		\$1,432,821.06

**TABLE No. 96. WATER WORKS EXTENSION ACCOUNT.**

Transferred back to Water Works Extension Account—Ordinance No.26,927	\$	718.31
Transferred back to Water Works Extension Account—Ordinance No.27,411		6,147.62
Unexpended balance transferred back to Revenue.....	\$	6,865.93
	\$	6,865.93
	\$	6,865.93

**TABLE No. 97. WATER WORKS RECONSTRUCTION ACCOUNT.**

Transferred by Ordinance No. 29,525 from Ordinance No. 28,129.....	\$	22,000.00
Transferred by Ordinance No. 29,525 from Ordinance No. 28,424.....		28,000.00
Appropriated by Ordinance No. 29,742.....		20,000.00
Appropriated by Ordinance No. 29,879.....		225,000.00
Reappropriated for the construction of two 48-inch manifolds connecting up Pump Mains High Service Pumping Station No. 2, Bissell's Point, Ordinances Nos. 29,525 and 29,742.....	\$	70,000.00
Reappropriated for the construction of the Steam Plant High Service Station No. 3—Baden, Ordinance No. 29,942.....	225,000.00	
Transferred back to Water Works Reconstruction Account, Ordinance No. 27,487.....		2,049.60
Transferred back to Water Works Reconstruction Account, Ordinance No. 27,968.....		4,534.37
Transferred back to Water Works Reconstruction Account, Ordinance No. 27,969.....		41.18
Transferred back to Water Works Reconstruction Account, Ordinance No. 29,342.....		3,790.67
Transferred back to Water Works Reconstruction Account, Ordinance No. 29,343.....		284.92
Unexpended Balance Transferred Back to Revenue.....	10,700.74	
	\$	305,700.74
	\$	305,700.74

**TABLE No. 98. WATER PIPE CONTRACT ACCOUNT.**

Appropriated by Ordinance No. 29,796.....	\$	160,000.00
Reappropriated to Purchase Water Pipe Special Castings, Valves, Fire Hydrants, Valve Boxes and Fire Hydrant Boxes.....	\$	160,000.00
	\$	160,000.00
	\$	160,000.00

**TABLE No. 99. WATER MAIN CLEANING ACCOUNT.**

Appropriated by Ordinance No. 29,660.....	\$	50,000.00
Reappropriated for the Examination, Inspection and Cleaning of Water Mains, Ordinance No. 29,690.....	\$	50,000.00

**TABLE No. 100. ASSESSMENT AND COLLECTION OF WATER RATES.**

Total Gross Collection, Water Rates.....	\$2,779,039.13	
Total Gross Collection, Miscellaneous.....	3,895.45	\$2,782,934.58
Less Discounts Allowed.....	\$ 252,202.60	
Less Licenses Redeemed.....	45,698.05	
Less Commissions on Collections.....	35,631.67	333,532.32
Total Net Collections.....		\$2,449,402.26
*Assessment of Water Rates.....	\$ 71,375.89	
Collection of Water Rates.....	35,631.67	
	\$ 107,007.56	

\* Included in operation and maintenance of Water Division.

TABLE No. 101. SHOWING CONDITION OF THE WATER WORKS REVENUE.

Year	Unappropriated Balance to Credit at Beginning of Fiscal Year	Collections	Transfers	Total Amount Available	Appropriated for Water Pipe and Laying	Appropriated for Works Extension	Appropriated for Water Works Reconstruction	Appropriated for Electric Plant and Railway	Appropriated for Protecting Water Supply and Engineers' Commission	Appropriated for Water Meters
1879	\$ 8,380.11	\$ 548,870.00	\$ 10.00	\$ 557,261.01	\$ 89,550.16	.....	.....	.....	.....	.....
1880	52,527.77	624,565.43	.....	677,093.20	677,093.20	.....	.....	.....	.....	.....
1881	16,434.90	657,192.02	.....	673,626.92	93,481.24	.....	.....	.....	.....	.....
1882	2,506.12	702,351.33	1,576.80	701,422.01	34,202.80	.....	.....	.....	.....	.....
1883	5,309.31	717,948.49	2,701.65	725,959.45	64,981.00	.....	.....	.....	.....	.....
1884	25,707.08	733,791.36	1,225.72	760,724.16	106,879.26	.....	.....	.....	.....	.....
1885	1,634.93	757,411.61	1,279.53	760,326.07	338,036.70	.....	.....	.....	.....	.....
1886	5,839.05	796,756.71	1,085.84	803,681.60	236,519.67	.....	.....	.....	.....	.....
1887	186,671.25	865,206.55	297.05	1,032,174.85	107,137.54	.....	.....	.....	.....	.....
1888	604,734.46	919,748.33	186.78	1,524,669.57	264,106.44	.....	.....	.....	.....	.....
1889	766,091.83	952,689.25	1,844.39	1,720,625.47	17,365.07	.....	.....	.....	.....	.....
1890	326,707.59	1,017,016.20	2,439.23	1,403,153.02	59,589.49	.....	.....	.....	.....	.....
1891	126,102.80	1,132,088.40	3,235.48	1,261,426.74	74,866.49	.....	.....	.....	.....	.....
1892	59,546.71	1,173,998.30	188.20	1,233,733.21	181,430.62	.....	.....	.....	.....	.....
1893	75,505.96	1,235,933.25	190.03	1,311,629.29	100,000.00	.....	.....	.....	.....	.....
1894	94,743.49	1,250,935.25	366.46	1,346,045.20	179,429.70	.....	.....	.....	.....	.....
1895	22,175.18	1,264,253.60	2,356.06	1,288,784.84	337,907.62	.....	.....	.....	.....	.....
1896	71,973.94	1,310,412.45	2,255.45	1,384,641.84	312,336.09	.....	.....	.....	.....	.....
1897	342,271.64	1,335,635.20	3,194.93	1,681,101.77	375,788.97	.....	.....	.....	.....	.....
1898	282,325.82	1,388,564.45	1,597.61	1,672,487.88	269,000.00	.....	.....	.....	.....	.....
1899	454,266.77	1,372,713.35	2,969.60	1,829,949.72	378,735.04	.....	.....	.....	.....	.....
1900	618,151.07	1,482,253.80	1,100.95	2,101,505.82	524,982.35	.....	.....	.....	.....	.....
1901	920,864.30	1,607,168.82	13,704.69	2,541,737.81	225,000.00	.....	.....	.....	.....	.....
1902	995,693.91	1,756,565.90	1,395.04	2,753,654.84	500,000.00	.....	.....	.....	.....	.....
1903	1,541,431.85	1,748,541.21	47,528.27	3,337,501.33	290,000.00	.....	.....	.....	.....	.....
1904	1,826,240.99	1,903,381.65	363,638.22	3,620,128.44	490,000.00	.....	.....	.....	.....	.....
1905	2,020,332.43	1,983,381.65	3,519.38	3,317,352.30	385,000.00	.....	.....	.....	.....	.....
1906	1,632,718.27	1,702,140.47	4,826.89	3,397,331.58	413,000.00	.....	.....	.....	.....	.....
1907	1,432,244.16	1,740,260.53	183,444.57	3,229,944.87	380,000.00	.....	.....	.....	.....	.....
1908	1,119,849.25	1,926,651.05	21,300.19	2,702,270.09	210,000.00	.....	.....	.....	.....	.....
1909	818,764.75	1,862,205.15	11,287.56	2,702,270.09	175,000.00	.....	.....	.....	.....	.....
1910	963,149.89	2,028,045.14	7,038.78	3,346,047.52	260,000.00	.....	.....	.....	.....	.....
1911	1,258,644.73	2,080,364.01	188,800.54	3,890,981.11	524,000.00	.....	.....	.....	.....	.....
1912	1,545,830.02	2,156,350.55	173,383.63	3,843,868.21	175,000.00	.....	.....	.....	.....	.....
1913	1,248,570.42	2,421,914.16	110,657.55	3,279,827.72	100,000.00	.....	.....	.....	.....	.....
1914	902,379.59	2,266,790.58	14,634.48	2,826,475.38	40,000.00	.....	.....	.....	.....	.....
1915	605,474.08	2,206,366.82	148,650.73	3,241,615.01	450,000.00	.....	.....	.....	.....	.....
1916	939,827.51	2,153,136.77	8,710.89	3,052,134.48	125,000.00	.....	.....	.....	.....	.....
1917	696,928.89	2,346,494.70	76,385.78	3,332,086.32	160,000.00	.....	.....	.....	.....	.....
1918	788,722.70	2,466,977.84	.....	.....	.....	.....	.....	.....	.....	.....
Total	.....	\$58,411,664.48	\$1,435,312.65	.....	\$9,057,346.25	.....	.....	.....	.....	.....
						\$12,173,841.46	\$2,277,500.00	\$102,500.00	\$158,073.21	\$190,000.00

\* Overdraft.

TABLE No. 101. SHOWING CONDITION OF THE WATER WORKS REVENUE—Continued.

Year	Appropriated for Sprinkling Plugs	Appropriated for Clarifying and Purifying Water	Appropriated for Testing Laboratory	Appropriated for Reinspection of Buildings and other Sources	Appropriated for Two Passenger Cars	Appropriated for Water Main Cleaning	Appropriated for Leak Detection	Appropriated for Locomotives	Appropriated for Automobiles	Appropriated for Constructing and Erecting Pumping Plant City Sanitarium	Appropriated for Public Service Commission	Cost Furnishing Light Through Lighting Dept. for Five Years, ending April 1st, 1911
1879	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1880	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1881	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1882	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1883	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1884	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1885	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1886	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1887	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1888	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1889	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1900	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1901	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1902	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1903	.....	\$110,000.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1904	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1905	.....	.....	\$7,000.00	.....	.....	.....	.....	\$10,000.00	.....	.....	.....	.....
1906	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1907	.....	.....	.....	.....	.....	.....	.....	.....	\$7,000.00	.....	.....	.....
1908	.....	.....	.....	.....	.....	.....	.....	.....	.....	\$74,000.00	.....	.....
1909	.....	.....	.....	.....	.....	.....	.....	.....	.....	17,100.00	.....	.....
1910	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1911	.....	.....	.....	\$25,000.00	.....	.....	.....	.....	.....	.....	.....	.....
1912	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1913	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1914	.....	.....	.....	.....	\$15,000.00	.....	.....	.....	.....	.....	.....	.....
1915	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1916	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1917	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1918	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	\$100,000.00	\$110,000.00	\$7,000.00	\$25,000.00	\$15,000.00	\$56,500.00	\$5,000.00	\$10,000.00	\$7,000.00	\$91,100.00	\$2,000.00	\$2,385.09

† Account of examination of report on City Water Works System.

TABLE No. 101. SHOWING CONDITION OF THE WATER WORKS REVENUE—Continued.

Year	Expended for Assessment and Collection of Water Rates	Expended for Operating and Maintaining Water Division	Expended for Special Tax Bills	Expended for Interest on Water Bonds and Sinking Fund	Expended for Fitting up New City Hall	Expended for Relief Bills	Transferred to Municipal Revenue	Unappropriated Balance at End of Fiscal Year
1879	\$ 29,445.15	\$ 196,907.98	.....	\$ 248,380.11	.....	.....	\$830,000.00	\$ 52,527.77
1880	34,499.43	202,009.89	.....	280,000.00	.....	.....	\$ 54,598.82	16,434.90
1881	38,193.21	234,156.59	.....	312,000.00	.....	.....	.....	2,506.12
1882	36,823.21	260,049.42	.....	167,000.00	.....	137.12	.....	5,809.31
1883	36,977.50	267,106.39	\$ 5,021.46	110,000.00	.....	.....	.....	25,707.08
1884	41,917.95	269,390.36	902.39	73,000.00	.....	2,700.00	.....	1,634.93
1885	47,926.84	264,704.44	.....	.....	.....	2,200.00	.....	5,839.05
1886	42,578.33	245,034.35	.....	85,000.00	.....	.....	.....	186,671.25
1887	50,505.66	240,990.45	1,376.97	.....	.....	1,769.50	.....	604,734.46
1888	51,984.06	248,580.62	.....	.....	.....	.....	.....	766,091.83
1889	51,025.06	278,463.68	475.00	.....	.....	1,404.10	.....	383,707.59
1890	50,944.21	264,306.49	.....	.....	.....	250.00	.....	126,102.86
1891	51,626.54	278,392.09	.....	.....	.....	153.00	.....	59,546.71
1892	51,933.60	327,592.04	.....	.....	.....	.....	.....	75,505.96
1893	53,867.64	349,978.34	.....	.....	.....	1,362.57	.....	94,743.49
1894	57,504.69	385,104.67	.....	.....	.....	.....	.....	22,175.18
1895	57,576.77	436,167.52	2,227.00	.....	.....	90.00	.....	71,973.94
1896	57,436.80	416,103.26	.....	.....	.....	270.75	.....	342,571.64
1897	57,118.75	438,758.50	.....	.....	.....	.....	.....	282,325.82
1898	57,333.77	443,631.94	.....	.....	.....	.....	.....	454,266.77
1899	59,095.89	463,052.13	.....	.....	\$13,000.00	2,915.60	.....	618,151.07
1900	57,649.86	493,179.56	.....	.....	.....	.....	.....	920,864.30
1901	60,238.40	534,594.68	3,226.21	.....	.....	2,500.00	.....	995,693.91
1902	64,229.68	547,221.53	.....	.....	.....	.....	.....	1,541,431.85
1903	65,083.24	562,787.92	.....	.....	.....	.....	.....	1,826,240.99
1904	64,064.14	589,357.84	.....	222,365.65	.....	250.00	.....	2,020,332.43
1905	64,427.90	836,589.10	.....	522,365.65	.....	5,151.81	.....	1,652,718.27
1906	63,378.81	825,751.10	.....	522,365.65	.....	15,375.08	.....	1,452,244.16
1907	63,580.33	843,886.02	.....	521,435.15	.....	3,397.85	.....	1,119,849.25
1908	68,884.62	911,389.85	.....	993,905.65	.....	34,507.65	.....	818,764.75
1909	70,337.18	901,481.47	.....	480,000.00	.....	3,101.55	.....	963,149.89
1910	77,027.72	967,602.75	.....	476,759.00	.....	751.30	.....	1,258,644.73
1911	77,027.09	949,029.03	.....	433,789.00	.....	60.00	.....	1,345,830.02
1912	79,363.08	1,006,999.91	.....	433,789.00	.....	.....	.....	1,248,570.42
1913	83,456.63	1,037,232.99	.....	433,789.00	.....	.....	.....	902,379.59
1914	86,047.41	1,097,968.53	.....	433,722.50	.....	1,315.20	300.00	605,474.08
1915	59,963.01	1,196,762.36	.....	401,722.50	.....	10,200.00	.....	939,827.51
1916	.....	1,187,768.47	.....	401,722.50	.....	195.15	.....	696,928.89
1917	.....	1,242,412.12	27,227.16	401,722.50	.....	2,050.00	.....	788,722.70
1918	.....	1,562,786.91	634.74	401,722.50	.....	3,450.00	.....	858,492.17
	\$2,119,951.16	\$23,805,283.49	\$41,090.93	\$8,356,586.36	\$13,000.00	\$95,558.38	\$184,150.42	.....

\* Overdraft.

† Account lighting waterworks plant during ten years out of municipal revenue.

‡ Account paving Baden Avenue paid out of municipal revenue.

\* Account of examination of report on city water works system.

§ Account water pipe laid during previous year paid out of municipal revenue.

|| Account lighting waterworks plant paid out of municipal revenue.

¶ Account supplies and labor paid out of municipal revenue.

## SUMMARY OF STATISTICS

For the Year Ending April 1st, 1918,

In Form Recommended by the New England Water Works Association.

### ST. LOUIS WATER WORKS.

#### GENERAL STATISTICS.

Population by census of 1910.....687,089

Date of construction.....1829-1918

NOTE: In 1829 the City of St. Louis granted an exclusive franchise to private parties to build waterworks and supply water. In 1835 the City acquired ownership of the works at a total cost of \$54,000.00. The location of Low Service Pumping Stations was changed in 1871 and again in 1892. The waterworks, as a whole, has been building and increasing in capacity for eighty-seven years.

By whom owned.....City of St. Louis

Source of supply.....Mississippi River

#### Mode of Supply:

The entire supply is pumped from the Mississippi River at the Chain of Rocks into seven settling basins, having a total capacity of about 200,000,000 gallons. Sedimentation is hastened through the addition of lime and sulphate of iron. The water is then passed through rapid sand filters, having a total rated capacity of 160,000,000 gallons per twenty-four hours. It is then delivered by gravity through conduits for a distance of three and one-half miles in one case, and seven miles in the other, to High Service Pumping Stations, where it is pumped into the mains. Practically one-half the supply is pumped into mains connected to Compton Hill Reservoir, 185 feet above city directrix, and the other half delivered under direct pressure approximately 35 pounds per square inch greater than the Compton Hill pressure.

**PUMPING STATISTICS.****1. BUILDERS OF PUMPING MACHINERY:****Chain of Rocks Low Service Pumps.**

- No. 6. E. P. Allis Co. Vertical Compound Engine, built in 1895, capacity 30-million gallons per twenty-four hours; was run 226 equivalent days during the year.
- No. 7. Allis-Chalmers Vertical Compound Engine, built in 1895, capacity 30-million gallons per twenty-four hours; was run 291 equivalent days during the year.
- No. 8. Allis-Chalmers Vertical Compound Engine, built in 1898, capacity 30-million gallons per twenty-four hours; was run 232 equivalent days during the year.
- No. 9. Allis-Chalmers Vertical Compound Engine, built in 1898, capacity 30-million gallons per twenty-four hours; was run 274 equivalent days during the year.
- No. 4. DeLaval Twin Centrifugal, steam turbine-driven, built in 1912, capacity 40-million gallons per twenty-four hours; was run 197 equivalent days during the year.
- No. 5. DeLaval Twin Centrifugal, steam turbine-driven, built in 1912, capacity 40-million gallons per twenty-four hours; was run 164 equivalent days during the year.

**Baden High Service Pumps.**

- No. 7. E. P. Allis Co. Triple Expansion High Duty Engine, built in 1898, capacity 10-million gallons per twenty-four hours; was run 138 equivalent days during the year.
- No. 8. E. P. Allis Co. Triple Expansion High Duty Engine, built in 1898, capacity 10-million gallons per twenty-four hours; was run 148 equivalent days during the year.
- No. 9. E. P. Allis Co. Triple Expansion High Duty Engine, built in 1898, capacity 15-million gallons per twenty-four hours; was run 226 equivalent days during the year.
- No. 10. E. P. Allis Co. Triple Expansion High Duty Engine, built in 1898, capacity 15-million gallons per twenty-four hours; was run 234 equivalent days during the year.
- No. 11. E. P. Allis Co. Triple Expansion High Duty Engine, built in 1902, capacity 15-million gallons per twenty-four hours; was run 253 equivalent days during the year.
- No. 12. E. P. Allis Co. Triple Expansion High Duty Engine, built in 1902, capacity 15-million gallons per twenty-four hours; was run 240 equivalent days during the year.

**Bissell's Point High Service Pumps.**

- No. 1. Allis-Chalmers Vertical Triple Expansion High Duty Engine, built in 1903, capacity 20-million gallons per twenty-four hours; was run 241 equivalent days during the year.
- No. 2. Allis-Chalmers Vertical Triple Expansion High Duty Engine, built in 1904, capacity 20-million gallons per twenty-four hours; was run 270 equivalent days during the year.
- No. 3. Allis-Chalmers Vertical Triple Expansion High Duty Engine, built in 1905, capacity 20-million gallons per twenty-four hours; was run 249 equivalent days during the year.
- No. 6. Holly Vertical Triple Expansion High Duty Engine, built in 1914, capacity 20-million gallons per twenty-four hours; was run 258 equivalent days during the year.
- No. 13. Holly Vertical Triple Expansion High Duty Engine, built in 1914, capacity 20-million gallons per twenty-four hours; was run 305 equivalent days during the year.
- No. 14. Cameron Two-stage Centrifugal, steam turbine-driven, built in 1915, capacity 20-million gallons per twenty-four hours; was run 5 equivalent days during the year.

**2. DESCRIPTION OF COAL USED:**

Bituminous coal from Illinois mines.

Price per ton of 2,000 pounds—

(a) Egg coal (2 to 5-inch size)—

Baden .....\$2.53

Bissell's Point..... 2.51

(b) Inch and one-half screenings—

Chain of Rocks..... 2.67

Percentage of ash: (a) (b)  
20 20

**3. COAL CONSUMED DURING THE YEAR, IN POUNDS:**

Chain of Rocks: (b) 38,793,884

Baden: (a) 40,863,552

Bissell's Point: (a) 45,616,093

**4. POUNDS OF WOOD CONSUMED, DIVIDED BY THREE, EQUALS EQUIVALENT AMOUNT OF COAL, NONE.****4a. AMOUNT OF OTHER FUEL USED, NONE.**

5. TOTAL EQUIVALENT COAL CONSUMED FOR THE YEAR (3)+(4) ..... POUNDS.

6. TOTAL PUMPAGE FOR THE YEAR:

Measured through Venturi meters and by plunger displacements with allowance for slip, as follows:

Chain of Rocks, by Venturi meters...39,317,500,000 gallons

Baden, by plunger displacement....15,564,298,400 gallons

Bissell's Point, by Venturi meters

and plunger displacement.....22,525,617,895 gallons

7. AVERAGE STATIC HEAD AGAINST WHICH PUMPS WORK:

Chain of Rocks..... 50.9 feet

Baden .....215. feet

Bissell's Point (six engines).....168. feet

8. AVERAGE DYNAMIC HEAD AGAINST WHICH PUMPS WORK:

Chain of Rocks..... 59.3 feet

Baden .....288. feet

Bissell's Point (six engines).....185. feet

9. NUMBER OF GALLONS PUMPED PER POUND OF EQUIVALENT COAL (5):

Chain of Rocks.....1,014 gallons

Baden ..... 381 gallons

Bissell's Point (six engines)..... 494 gallons

10. DUTY=GALLONS PUMPED (6)X8.34 (POUNDS)X100X DYNAMIC HEAD (8) TOTAL FUEL CONSUMED (5):

Compound engines, Chain of Rocks.....57,000,000

Centrifugal engines, Chain of Rocks.....37,300,000

Triple expansion engines, Baden.....90,100,000

Triple expansion engines, Bissell's Point.....76,200,000

**Cost of Pumping, Figured on Pumping Station Expenses Alone.**

11. PER MILLION GALLONS PUMPED:

(a) Into settling basins at Chain of Rocks...\$ 3.20

(b) Into mains at Baden..... 8.984

(c) Into mains at Bissell's Point..... 6.825

(d) Average cost per million gallons for pumping twice (a) plus average of (b) and (c). 11.009

12. PER MILLION GALLONS RAISED ONE FOOT (DYNAMIC):

Chain of Rocks.....\$0.0542

Baden ..... .0312

Bissell's Point..... .0369

## CHAIN OF ROCKS FILTERS.

Designed and Built by Water Division  
of St. Louis.

### DESCRIPTIVE DATA.

1. Complete.....November, 1915
2. Total cost.....\$3,550,000.00  
(Includes land, basins, conduits, coagulant house, filters, etc., but not pumping station nor clear water storage basins.)
3. Source of supply.....Mississippi River, five miles below junction of Missouri River
4. Rated capacity.....160,000,000 gallons daily
5. Method of Purification :  
Grit, removal, softening with lime, coagulation with iron, sedimentation, coagulation with sulphate of alumina, filtration, sterilization with chlorine.
6. Total Capacity of Basins :  

Grit chamber.....	800,000 gallons
Mixing conduits.....	5,580,000 gallons
Settling basins, 1-6 and 9.....	220,660,000 gallons
Mixing chamber.....	4,560,000 gallons
Secondary sedimentation basins 7 and 8..	63,750,000 gallons
Total.....	
	295,350,000 gallons
7. Total Working Capacity of Filtered Water Basins :  

Baden Storage Reservoir.....	20,000,000 gallons
Bissell's Point Storage Basins.....	60,000,000 gallons
Compton Hill Reservoir.....	85,000,000 gallons
8. Chemicals Used :  
Lime, sulphate of iron, sulphate of alumina and liquid chlorine.
9. Where Chemicals are Applied (ordinary conditions) :  

Lime at entrance of mixing conduits after water has passed through grit chamber.
Sulphate of iron at exit from mixing conduits.
Sulphate of alumina, in conduit between primary sedimentation basins and secondary mixing chamber; in influent flume leading to filters and after washing; in central gutter of each filter to incoming water for a few minutes.
Liquid chlorine to filter effluent in drawing conduit chamber.

## 10. How Applications of Chemicals are Made :

Lime, weighed dry, slaked and pumped as milk of lime from Coagulant House, 1,110 feet to point of application in mixing conduit.

Sulphate of iron, measured by volume, pumped as solution Coagulant House, 865 feet to point of application in mixing conduit.

Sulphate of alumina, made into solutions in Head House, pumped to automatic chemical feeders, Venturi meter controlled, for application to settled water; pumped to hand-operated chemical feeders for application in influent flume; pumped to nozzles at each filter for application in filter boxes.

Liquid chlorine fed through calibrated meters to solution towers; applied as solution.

11. Number of Filter Units.....40

12. Net Area of Filter Surfaces.....56,000 square feet

13 and 14. Depths of Filtering Material and Sizes :

Gravel .....	2" to $\frac{3}{4}$ "	5" }	From Meramec River.
	$\frac{3}{4}$ " to $\frac{3}{8}$ "	4" }	
	$\frac{3}{8}$ " to $\frac{3}{16}$ "	3" }	

Sand.....From Mississippi River, depth 30"  
Effective sizes vary from 0.31 mm. to 0.46 mm. in the different filters.

15. Method of Cleaning Filter Beds :

High velocity water wash, maximum 24" rise.

16. Number of Subsiding or Coagulating Basins.....9

17. How Rate of Filtration is Controlled :

By Builders' Iron Foundry rate controllers, arranged for setting from one central point or at each filter. Rate of filtration determined by superintendent on watch from elevations of water in storage basins.

For Statistics of Analyses, see pages 64-85.

## FINANCIAL STATISTICS.

## RECEIPTS.

Unexpended balance in Water Works Revenue beginning of Fiscal Year . . .		\$ 788,722.70
Unexpended balance in Ordinance Accounts . . . . .		781,276.06
		<hr/>
From Water Rates:		\$1,569,998.76
Flat Rates—Gross . . . . .	\$1,678,661.05	
Meter Rates—Gross . . . . .	1,100,378.08	\$2,779,039.13
		<hr/>
For Taps—Gross . . . . .	\$ 3,733.45	
For Miscellaneous—Gross . . . . .	162.00	3,895.45
		<hr/>
From Municipal Railway . . . . .		7,531.90
From Ground and Pole Rental . . . . .		22.60
From the Sale of Condemned Material . . . . .		9,225.40
From County Water Licenses . . . . .		787.18
From other Departments for work done . . . . .		10,777.25
From Unpaid Payrolls . . . . .		194.57
From Contract and other Deposits . . . . .		27,672.73
From Excess Commissions Refunded . . . . .		57,173.08
From Miscellaneous . . . . .		8.50
		<hr/>
		\$ 4,466,326.55

## EXPENDITURES.

OPERATION AND MAINTENANCE . . . . .	\$1,517,767.82
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## SPECIAL—

Motor Trucks—Distribution Section, S. S. Branch . . . . .	3,324.15
Repairs to Paved Streets—Distribution Section, S. S. Branch . . . . .	5,240.47
Pitometer and Equipment—Distribution Section, S. S. Branch . . . . .	605.86
Gate House, Compton Hill—Distribution Section, S. S. Branch . . . . .	2,034.84
Superheaters and Check Valves—O. S. Bissell's Point Branch . . . . .	887.20
Auxiliary Conveyor for Storage Shed—O. S. Bissell's Point Branch . . . . .	1,116.55
Steel Bins, Store Room—O. S. Bissell's Point Branch . . . . .	437.50
Impellers for Pumps Nos. 4 and 5—O. S. Chain of Rocks Branch . . . . .	408.80
Motor Vehicles—Distribution Section, Meter and Tap Branch . . . . .	1,112.77
Purchase of Water Meters—Distribution Section, Meter and Tap Branch . . . . .	11,699.00
Guard Rail Plates, Sanitarium Switch—Supply and Purifying Section . . . . .	933.10
Gondola Car—Supply and Purifying Section . . . . .	2,250.00
Ford Automobile—Supply and Purifying Section . . . . .	359.30
War Protection—Supply and Purifying Section . . . . .	42,908.10
Runabouts—Assessment Section . . . . .	1,526.89

## ORDINANCE ACCOUNTS—

For Extending Distribution System . . . . .	\$ 181,558.03
For Construction of Filler Equipment . . . . .	420.00
For Reconstruction of Boiler Plant—Low Service Station . . . . .	1,158.81
For Reconstruction of Pumping Plant No. 2—High Service Station No. 1 . . . . .	34,519.33
For Construction of Smokestack, etc.—Low Service Station . . . . .	575.19
For Constructing and Installing Equipment Necessary for Operating Pumping Engines, Pumping Plant No. 1—High Service Station No. 1 . . . . .	693.60
For Reconstruction of Compton Hill Reservoir . . . . .	60,774.58
For Construction of a Reinforced Conduit—Baden to Bissell's Point . . . . .	117,366.47
For Construction of Smokestack, etc., High Service Station No. 2—Bissell's Point . . . . .	24,632.77
For the Installation of one 100-million-gallon Steam Turbine Driven Centrifugal Pump—Low Service Station . . . . .	5,790.80
For Wrecking and Rebuilding No. 111 Chestnut Street . . . . .	11,209.33
For Purchasing and Installing three new cylinder heads, Engines Nos. 1, 2, 3—High Service Station, Bissell's Point . . . . .	4,715.08
For Constructing and Extending Hurdle Dikes, etc., into Mississippi River Opposite Low Service Station—Chain of Rocks . . . . .	74,786.44
For Constructing Two 48-inch Manifolds Connecting Pump Mains—High Service Station, Bissell's Point . . . . .	32,451.43
For Examining and Cleaning Water Mains . . . . .	23,835.05
For Reconstructing Steam Plant—High Service Station No. 3, Baden . . . . .	2,020.55
For Interest . . . . .	101,722.50
For Sinking Fund . . . . .	300,000.00
For Special Tax Bills . . . . .	634.74
For Relief Bills . . . . .	3,450.00
For Discounts Allowed in Water Licenses . . . . .	252,202.60
For Water Licenses Redeemed . . . . .	45,698.05
For Commissions on Water Licenses Collected . . . . .	92,804.75
Unexpected Balance in Water Works Revenue . . . . .	858,492.17
Unexpected Balance in Ordinance Accounts . . . . .	642,181.93

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\$4,466,326.55

Net Cost of Water Works to date . . . . .	\$32,139,407.79
Bonded Debt to date . . . . .	2,624,000.00
Payments into Sinking Fund and Interest to date . . . . .	8,356,586.36
Balance in Sinking Fund to date . . . . .	908,766.59
Average Rate of Interest, 3.65—4%	

### STATISTICS OF CONSUMPTION OF WATER.

1. Estimated total population at date.....	770,000
2. Estimated population in lines of pipe.....	765,000
3. Estimated population supplied.....	765,000
4. Total consumption for the year.....	38,089,916,295 gallons
5. Passed through meters.....	11,274,615,223 gallons
6. Percentage of consumption metered.....	29.6
7. Average daily consumption.....	104,355,935 gallons
8. Gallons per day to each inhabitant.....	135
9. Gallons per day to each consumer.....	135
10. Gallons per day to each tap.....	856

### STATISTICS RELATING TO DISTRIBUTION SECTION.

#### Mains.

- Kind of pipe, cast iron and steel.
- Sizes from 3" to 48".
- Extended 35,917' during year.
- Discontinued 804' during the year.
- Total now in use, 1,009.4 miles.
- Length of pipe, 4" and less in diameter, 18.2 miles.
- Number of hydrants added during year (public and private), 91.
- Number of hydrants (public and private) now in use, 12,011.
- Number of stop gates added during the year, 143.
- Number of stop gates now in use, 12,765.
- Number of stop gates smaller than 4", 2,172.
- Number of blow-offs, 212.
- Range of pressure on mains, 15 to 125 pounds.

#### Services.

- Kind of pipe, lead and cast iron.
- Sizes,  $\frac{5}{8}$ " to 6".
- Number of service taps added during year, 1,183.
- Number now in use, 118,122.
- Average length of service, 40'.
- Number of meters added, 182.
- Number now in use, 8,508.
- Percentage of receipts from metered water,  $39\frac{1}{2}$  per cent.
- Percentage of service metered, 7.2 per cent.









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